THE

ELECTRICAL REVIEW.

VOL. LX. MARCH 1, 1907. No. 1,527.

ELECTRICAL REVIEW.

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READY!

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1907 EDITION.

H. ALABASTER, GATEHOUSE & CO.,

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THE LEGAL RIGHTS OF ELECTRICAL CONTRACTORS.

ELECTRICAL contractors who have occasion to deal with local authorities must needs walk warily, if they desire to avoid the numerous legal pitfalls which infest any contractual relationship with a municipal body. From time immemorial, the laws of England have prescribed certain formalities which must be observed if a local authority is to be held to its bargain. Thus a contract with a local authority must, in nearly every case, be under seal; and it must provide for penalties in case of non-performance. And there is good reason why a local body should be compelled to observe strict formality in making binding contracts. The members of a Corporation or District Council are not spending their own money. It is the interests of the ratepayers which are entrusted to their care. If the rates could be drawn upon to provide for the fulfilment of any and every contract, however informal, the position of the ratepayer would be precarious indeed.

Contractors are doubtless aware of the steps which they must take in order that the local authority shall not be able to say, after expenses have been incurred for the part performance of the contract, "We are under no legal obligation to you." Bitter experience has shown that money laid out in performance of a contract not under seal may be entirely lost. But there are certain other matters of which the contractor must not lose sight, if he is anxious to make sure that his labours are not undertaken in vain.

A correspondent, whose letter appears in another part of this issue, has recently drawn our attention to a question which frequently arises in connection with contracts with local authorities. After a tender has been accepted, and the work has been actually begun, it may turn out that the local authority are unable to raise the funds necessary to carry out the contract, owing to the refusal of the Local Government Board to sanction a loan for the purpose. In some cases the specification contains a clause to the effect that the order placed by the Council will be subject to the sanction of the Local Government Board for the loan to meet the expenditure. Where the specification contains such a clause it is obvious that the most prudent course for the contractor will be to decline to commence operations or do any work at all until the sanction of the Board is obtained.

If he does not take that course it is reasonably clear that if the whole contract is conditional upon the loan being sanctioned, the contractor stands to lose his entire remuneration.

Some people are not wise until after the event. If the performance of the contract is commenced and expenses are incurred before the necessary sanction is obtained, what is the legal position? We are informed that in numbers o cases the Local Government Board inquiry is not held until some weeks or even months after the contractor has receive

intimation of the acceptance of his tender, and instruction to proceed. Seeing that the contract usually contains a time clause imposing penalties for delay upon the contractor, he is virtually compelled to get to work as soon as possible. If he does this, and the local authority are subsequently compelled to repudiate the contract, what remedy is open to the contractor? We confess we cannot see that he has any remedy. The contractor who enters into a bargain with a local body, or any other body for that matter, upon condition that payment is not to be made except in a certain event, seems to buy a pig in a poke. He cannot even pursue a remedy against the individual members of the local authority, for he consented from the first to look to the local authority as a body.

It will next be convenient to consider the rights of a contractor who has entered into a contract which contains no reference whatever to the raising of a loan or to the sanction of the Local Government Board. Assume that, in such a case, the contractor does the work, and when the time for payment comes, the local authority refuse to pay. He brings an action in the High Court. If he cannot recover from the local authority as a body, he can recover from them personally.

It is quite clear that a contractor can pursue no effective remedy against any officer of the local authority, for it is provided by Sec. 265 of the Public Health Act, 1875, that no matter or thing done, and no contract entered into by any local authority or joint board or port sanitary authority, and no matter or thing done by any member of such authority, or by any officer of such authority, or other person whomsoever acting under the direction of such authority, shall subject them to personal liability. To this section, however, there is appended the following important paragraph :—"Provided that nothing in this section shall exempt any member of any such authority from liability to be surcharged with the amount of any payment which may be disallowed by the auditor in the accounts of such authority, and which such member authorised or joined in authorising."

It has been decided that when the local authority enter into any contract they will be liable to the contractor in an action on the contract if it is broken by them, and he will not be compelled to proceed in equity or by *mandamus*, in the first place. The judgment, however, if given against a municipal corporation, will not operate as a charge upon the real estate belonging to them. It has further been decided that where a local authority enter into a contract *ultra vires* and cannot pay the contractor out of their funds, the individual members of the Board are not personally liable on that contract (Bailey *v.* Cuckson, 32 L.T.O.S., 124).

It is well to note, however, that a contract for which the Local Government Board refuse to allow monies to be raised is not necessarily *ultra vires*. At the same time, the auditor may disallow the loan.

A loan for the purposes of an electric light undertaking may be raised in accordance with Sec. 8 of the Electric Lighting Act, 1882, but the accounts of any receipts and expenditure by the local authority in pursuance of that Act, or any licence, order or special Act must be subjected to the audit which is prescribed in Sub-sec. 246-248 of the Public Health Act, 1875. An auditor acting in pursuance of Sec. 147 of the Act of 1875 must disallow every item of account which is contrary to law and surcharge the same on the person making or authorising the making of the illegal payment, and shall certify the amount due from such person. There is no power to surcharge a person not having a direct and immediate control over the funds out of which the illegal payment is made. Thus a surveyor cannot be surcharged for giving a certificate without which an illegal payment to a contract could not have been made.

Trolley Wire Suspension.

"There are about 8,000 of these half anchor ears in use in Dublin." These words occur in the paper read by Mr. Sheardown before the Dublin Section I.E.E. (see p. 121, Elec. Rev.) They refer to the fact that 4,000 trolley wire ears have caused trolley wheels to bump the wire so badly at the trailing end of each ear that, for the sake of safety, anchor ears have been attached at the distance of a foot or two on either side of the original ear. When at last the wire breaks it is held up by one of these anchors.

Assuming that there are 100 ears to a mile of track, Dublin has every ear on 40 miles anchored in this way; or, practically the whole of the system is so treated.

What a condemnation of the usual form of "fouling" ear on circular section wire! And Dublin is no exception to the general rule, for every busy line which is as old has anchors at every ear, or has had the original ears replaced by longer and longer ears to cover up the successive bumped weaknesses.

Both these methods are palliative only, and the only cure is to be sought in a modification of the ear, as Tweedy and Dudgeon showed clearly enough in a recent paper.

Directly an ear is used which either does not allow the trolley wheel to touch it, or presents to the wheel a surface flush at every point with the wire, and of no greater sectional area throughout the path of the wheel, the whole trouble due to bumping and arcing vanishes, and only the gradual weakening of the wire by crystallisation due to bending at points of suspension remains. That can be overcome in some measure by running the trolley wire as taut as circumstances will permit, and by seeing that the spans and bow-strings are doing something to justify the term "flexible suspension;" but perhaps the most satisfactory result will be obtained by using the new form of "tangential suspension" which we hear is to be applied on the extensions of the Derby Corporation tramways.

That suspension, with non-fouling ears, and No. 0 or 00 trolley wire, which can be used then, and then only, with impunity, will provide an example of construction which is cheaper, and far more durable, than any of the pseudo-"standard" construction to which we are accustomed.

Motor-Omnibuses.

The merits of the petrol motor-'bus have recently formed the subject for two valuable papers: Col. Crompton's before the Institution of Civil Engineers, treating very largely of public vehicles, and that read by Lord Montague of Beaulieu, before the Society of Arts on Wednesday, 13th. The figures given in Col. Crompton's paper being the result of experience and careful calculation, will be taken as a standard for comparison, and are quoted by Lord Montague to that effect. The comparison does not work out in favour of tramways.

In investigating the statistics of the two principal methods of street conveyance in relation to London traffic, we encounter a rather curious condition of things. We have, in London, probably the heaviest and most continuous traffic between the centre and the suburbs of any town in the world (with apologies to all American towns). In the

principal towns of the kingdom and capitals on the Continent, tramways are worked at a profit. Although it is difficult to arrive at the precise figures of the South London tramways, they are generally credited with a very small margin between receipts and expenses. The London United tramways make a certain living and work satisfactorily. In spite of the capital expenditure on the former undertaking, undoubtedly large, there should be a possibility of making it pay.

The old tendency of mankind to become enthusiastic over novelties is again exemplified. A few years ago someone discovered the Central London Railway in Oxford Street—the City and South London had then been running ten years—and at once, in a fever of excitement, announced that the traffic problem had been solved. The conversion of the horse tramways on the south side produced some sensation, especially among the natives of the hitherto unexplored district served, reducing a ride of 45 minutes' duration to 27 minutes (at that time). Finally came the motor-'bus, and our difficulties are transferred to it.

It seems a very questionable policy for tramways and tubes to attribute falling receipts to the introduction of the new vehicle. There is traffic enough for every kind of conveyance in London. Naturally, the swiftest has the preference, but, at the times of charge and discharge, it is almost invariably a case of money turned away. The person who really has cause of complaint against the motor-omnibus is the cabman. No one will take a cab to do in 20 minutes what he can do in 15 minutes by omnibus.

The cause of the alleged superiority of the latter vehicle over the tramcar is, of course, needless to remark, its ability to dodge and wind through the slower traffic. But that the tramway authorities should blame their loss of passengers to this vehicle is a mistake. The difference between the time in which a tramcar can be run over a long route, and the time taken by a motor-omnibus under similar conditions, is very small having regard to the street speed limit. The real cause of loss to the tramway is the heavy goods traffic, and this is the traffic which controls all the rest, and which every speaker on the question ignores. So long as we have processions of brewers' drays blocking our main streets at any and all times of the day, and so long as our pavements are so many wharves barricaded by cumbrous conveyances, we shall have congested traffic. When a subterranean goods traffic begins to be rendered necessary by enactments limiting the amount of street to be occupied by the two-mile-an-hour autocrat, we shall be better able to judge of the possibilities of tramway traction.

Tramcar Brakes.

In our issue of January 25th the improved mechanico-magnetic track brake which is being tested on the L.C.C. lines was ascribed to the B.T.-H. Co. in consultation with Mr. Fell; but we learn now upon the highest authority that the designs were made by the L.C.C. staff at the New Cross works. It is true that proposals from the British Westinghouse and the B.T.-H. Companies were considered in conjunction with these designs, but no very novel features were observed, and the L.C.C. proceeded to develop its own ideas.

The tests were carried out by the L.C.C. staff under Mr. Fell, and the apparatus was not inspected by the representatives of either company mentioned until it had been in service for some considerable time.

Evidently, therefore, we inadvertently did Mr. Fell and his staff less than justice; but it is well to add that the original statement was not made on the authority of the B.T.-H. Co.

THE ROYAL OBSERVATORY AND THE L.C.C. POWER STATION, GREENWICH.

The report of the Special Committee appointed to deal with this question, to which we referred recently, has now been published. The Committee consisted of the Earl of Rosse for the Observatory, Sir Ben. Baker for the L.C.C., and Prof. J. A. Ewing for the Admiralty. The report first details the existing conditions, and refers to the observations and experiments made by the Committee; it is accompanied by the figures reproduced on the next page.

The four generating sets, each of 3,500 kw., take steam from two banks of boilers, from which the gases are carried away by two chimneys rising 259·38 ft. above Trinity high-water mark. The chimney tops are 100 ft. above the horizon of the Observatory; the Greenwich Meridian (that of the main Transit circle) passes 15 ft. to the west of one of the two completed chimneys, and the meridian of the Altazimuth instrument passes to the east of both of them, but intersects one of the uncompleted chimneys of the second portion of the works, which rise to heights of 191·38 and 193·68 ft. respectively above high-water mark.

The Committee reports that the evidence is clear as to the vibrations set up by the working of the engines; they increase in intensity roughly in proportion to the number of engines running simultaneously, and are unlike any disturbance previously experienced by the Observatory. Fortunately, it has been found possible completely to damp out the vibrations in the mercury horizon, by using for the latter a very shallow pool of mercury (less than ½ mm. deep at the centre of a circle 15 cm. in diameter) lying on an amalgamated metal surface. The film, though fluid enough to assume the form of a horizontal plane under the action of gravity, apparently shares the motion of the ground like a rigid body, and affords a perfectly satisfactory reflecting surface.

Whether the vibrations—which of course are none the less, though their effects on the mercury have been masked—have any other injurious influence on the use of the instruments, the Committee cannot say. There is no evidence to that effect as yet, but the Committee carefully guards against any positive statement on the point.

As for the cause of the vibrations, and their possible cure, the Committee remarks that, while the type of engine adopted admits of very complete balance, unfortunately the engines have been designed without regard to this. To alter them now would be expensive and difficult. Prof. W. E. Dalby was called in to assist the Committee on this question, and showed in his report that the disregard of balancing in the design results in the application of forces due to inertia to the foundation block which are equivalent to 23 tons weight acting vertically, and 40 tons horizontally, for each element of the engine, 94 times per minute. The cost of a partial cure (viz., balancing the vertical forces only, by adding revolving balance weights) would be about £2,700 per engine. The Committee recommends that the question be left here for the present; if evidence later shows that the disturbance of the ground is prejudicial to the work of the Observatory, the matter should be reopened and a remedy found "either by balancing the engines or by removing them." No trouble is expected from the 20,000-kw. turbine installation; it is recommended that the latter alone be used after 8.30 p.m.

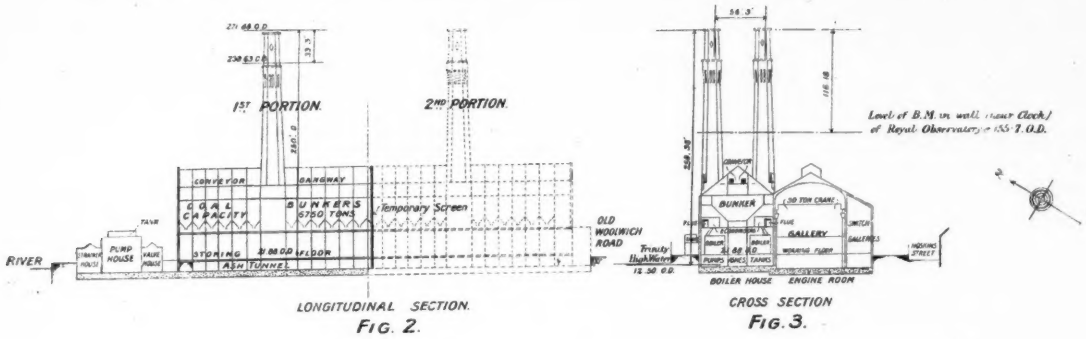
As regards the chimneys, the completed pair rise 2° 19′ above the horizon of the Transit circle, and the smoke and gases are estimated to rise 1½° to 2½° higher still, whereas formerly stars could be observed down to 2° above the horizon. The chimneys are reported to be higher than is necessary to provide the draught, and 33 ft. could be removed without injury to the working (this, too, we think, would greatly improve their appearance). The cost would be £1,900 for the two chimneys; but as these have not hitherto seriously affected the observations, the Committee does not recommend any immediate action in the matter. On the other hand, the Committee recommends that the unfinished chimneys be built no higher than at present, and that the temperature of the gases be kept down to 250° F.

The Committee concludes: "We are strongly of opinion that there should be no further extension on the present site. In our judgment, the station should not have been placed

there at all. . . A site near the Greenwich Observatory is the last place that should be chosen for the exceptional development of heat and power required in carrying out a scheme of distribution over the metropolitan area. . . A suitable site should be selected elsewhere for any extension that may be required, about which there should be no great

on which they are based are entirely wrong. What the correct premises should be I have stated repeatedly, and do not propose to do so again.

My object in taking up this discussion a second time was to show up the preprosterous claims put forward by Mr. Cramp; this object has now been so thoroughly achieved



LONGITUDINAL SECTION.
FIG. 2.

CROSS SECTION
FIG. 3.

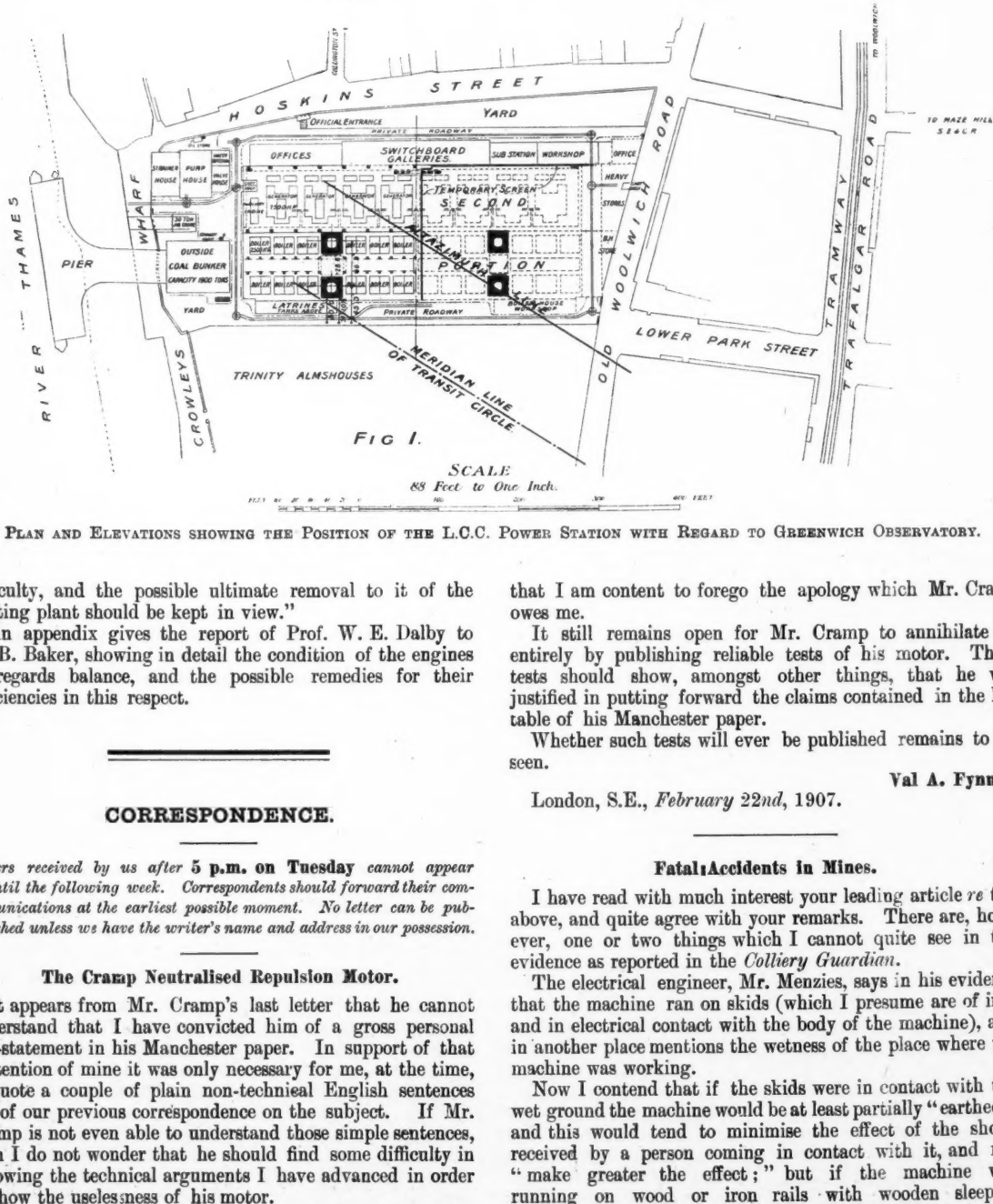


FIG 1.

SCALE
88 Feet to One Inch.

PLAN AND ELEVATIONS SHOWING THE POSITION OF THE L.C.C. POWER STATION WITH REGARD TO GREENWICH OBSERVATORY.

difficulty, and the possible ultimate removal to it of the existing plant should be kept in view."

An appendix gives the report of Prof. W. E. Dalby to Sir B. Baker, showing in detail the condition of the engines as regards balance, and the possible remedies for their deficiencies in this respect.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Cramp Neutralised Repulsion Motor.

It appears from Mr. Cramp's last letter that he cannot understand that I have convicted him of a gross personal mis-statement in his Manchester paper. In support of that contention of mine it was only necessary for me, at the time, to quote a couple of plain non-technical English sentences out of our previous correspondence on the subject. If Mr. Cramp is not even able to understand those simple sentences, then I do not wonder that he should find some difficulty in following the technical arguments I have advanced in order to show the uselessness of his motor.

As regards the formulæ which Mr. Cramp now brings forward, they have no value whatever because the premises that I am content to forego the apology which Mr. Cramp owes me.

It still remains open for Mr. Cramp to annihilate me entirely by publishing reliable tests of his motor. These tests should show, amongst other things, that he was justified in putting forward the claims contained in the last table of his Manchester paper.

Whether such tests will ever be published remains to be seen.

Val A. Fynn.

London, S.E., *February 22nd*, 1907.

Fatal Accidents in Mines.

I have read with much interest your leading article *re* the above, and quite agree with your remarks. There are, however, one or two things which I cannot quite see in the evidence as reported in the *Colliery Guardian*.

The electrical engineer, Mr. Menzies, says in his evidence that the machine ran on skids (which I presume are of iron and in electrical contact with the body of the machine), and in another place mentions the wetness of the place where the machine was working.

Now I contend that if the skids were in contact with the wet ground the machine would be at least partially "earthed," and this would tend to minimise the effect of the shock received by a person coming in contact with it, and not "make greater the effect;" but if the machine was running on wood or iron rails with wooden sleepers supporting them, the machine would be partially insulated and the shock much greater.

With regard to rule 11, that if the power below ground does not exceed 200 B.H.P. it is not necessary to have a competent person on duty below ground. This rule is a bad one, as anyone knows who has had any experience of electricity in mines; even 100 B.H.P. is too big a job to be safely dealt with by overmen or undermanagers, who, in spite of the increasing number of electrical questions which are appearing on their examination papers, as a general rule, know very little about electricity.

Now I would suggest that rule 11 should read 22 B.H.P. instead of 200, and the competent person should be an electrician who has passed some examination such as the City and Guilds Electric Lighting and Distribution of Power.

I am confident if this were done we should hear less of "electrical accidents" in mines.

I can quite agree with the pump incident, and may say I have known cases, if possible, even worse than that.

T. Hagues.

Dinnington, *February 19th*, 1907.

Rail Corrugation.

"Inspector" says, "There is no corrugation on a straight rail." I have made an examination and am inclined to think that his ideas are correct, although in the places affected the deviations out of line are hardly noticeable, and I may mention that for about twenty yards on either side of a stopping station the rails appear free from this defect. The slacker the curve the greater the trouble is, especially on down gradients, where cars attain a good speed, and in this case the deeper are the indents. It stands to common sense that a car with four wheels fast on the axles, and those axles fixed rigid with a six-foot base, cannot possibly negotiate a curve without the rail being badly worn and the motor work under the car being seriously strained or otherwise broken, and I suggest that a large proportion of broken axles (which break close to the bush of the wheel) may be attributed to the same cause.

Two wheels fast on one axle, can only revolve the same number of times in a given distance, and where one has to travel further than the other "something has to go." The outside wheels jump, and in jumping cause corrugation.

Foreman.

Wireless Telegraphy and the Admiralty Agreement.

Seeing that Mr. Justice Kekewich, in delivering judgment on February 15th, has laid it down from the bench that Mr. Cuthbert Hall, manager of the Marconi Wireless Telegraph Co., and of the Marconi International Wireless Co., is "a witness who is not worthy of credit," I do not propose to continue any further the correspondence in your columns in controversy with the person so described.

Your Correspondent.

Notes on Turbine Troubles.

On reading the article on the above subject in your issue of the 22nd inst., I was very much impressed with the benefits that may be derived by all interested in the working of steam turbines by making themselves fully acquainted with the difficulties or otherwise that other users of this class of machinery have met with.

As the readers of this paper will doubtless be interested in the discussion of the points raised, I should be glad if you would kindly grant me some space in which I may tender advice and describe the experience of those who have been, if I may say so, very fortunate in their use of steam turbines.

From the difficulties referred to throughout the article, especially those referring to bearing and blade troubles, I think I am right in presuming that the writer refers more particularly to the Parsons type of turbine. I have had 2½ years' experience with the Zoelly turbines, which are very largely used on the Continent, and can say that I have never encountered any of the mishaps mentioned.

I attribute the troubles the writer has experienced with the bearings (1) to the great weight of the rotating parts; (2) to the unequal distribution of supports of same; (3) to disalignment of same owing to unequal expansion; (4) to heat radiation from the turbine casing to the bearings, thus unduly warming the bearing metals and necessitating more lubrication and attention.

Owing to the construction of the Zoelly turbine, the weight of the rotating parts is extremely small, consisting, as they do, of an exceedingly small shaft and from five to nine steel disks. The shaft, in addition to being carried chiefly in the two main bearings in a similar manner to that in the Parsons turbine, practically obtains support throughout its whole length from the collars of the guide wheels, which are placed alternatively between each running disk.

As regards the unequal expansion and the resultant disalignment, the final temperature of the bearings and shaft is sooner attained, owing to the comparative lightness of the material employed in its construction and the small diameter of the shaft as compared with the large diameter of the drum in the Parsons type.

The fourth difficulty, namely, heat radiation, is completely overcome by mounting the bearings quite separately from the turbine casing.

The other difficulty mentioned, which I will discuss here, refers to blade stripping. As the Zoelly turbine is constructed with a clearance of about ¼ in. between the rotating blades and the casing of the stationary guide wheels, sufficient margin is left for any temporary unequal expansion in the disks, and also to allow any condensed steam, such as may be expected in starting up machinery before all parts are thoroughly heated, to pass away. As a matter of fact, blade stripping is an unknown occurrence with this type of machinery. Moreover, blade stripping, on account of centrifugal forces, which has also occurred in the Parsons type through loosening of the blades, which are caulked or brazed in, is impossible owing to the method of fastening these in grooves on the running disks. I think, therefore, that to avoid trouble, such constructional details should be carefully considered before the purchase of the machine is made.

Jens Orten-Böving.

London, S.W., *February 22nd*, 1907.

The Appointment of Municipal Electrical Engineers.

I have read with interest a letter in your issue of February 15th in reference to the above matter.

While agreeing with you correspondent that curious selections are at times made by Electricity Committees, I would remind "W. H." that the work of going through some hundreds of applications for an appointment is no light one, particularly in cases where the selection rests in the hands of Town Councillors and other non-technical men, and, with the array of talent available for the small salaries frequently offered, the task of making a wise selection is one of considerable difficulty.

Of course, cases often occur in which candidates having local influence obtain preference, and for this there seems to be no remedy; but I submit that very many municipal appointments are perfectly *bonâ-fide* and conscientiously made.

I notice that "W. H." refers to a municipal appointment recently made in a small town in the South of England. I have no difficulty in recognising the case to which he refers, as I was myself one of the candidates selected for interview, although unsuccessful. From information I received, and also from personal observation, I am absolutely convinced that every application received was read and considered, and that the appointment was given to a gentleman of undoubted ability whom the Council considered most suitable for the office, and as one who travelled many miles to be interviewed, I do not feel in any way aggrieved.

I think it is to be regretted that "W. H." should compare his qualifications with those of the successful candidate through the medium of the public Press, and to the detriment of the latter gentleman.

If "W. H.'s" application for the position resembled his letter referred to, it is obvious that the Council did not share his views regarding his *exceptional* qualifications, and I think

that, in view of the tone of his remarks, the Council are to be congratulated upon the manner in which "W. H.'s" application was dealt with.

In conclusion, I may add that I pen these remarks, because I feel that "W. H.'s" remarks are, in some respects, most offensive to, at least, one of the unsuccessful candidates.

Candidate.

The Necessity of Sound Technical Advice.

The enclosed letter, which I culled from the columns of the *Timber Trades Journal* of February 16th, may possibly be of some interest to your readers. Such letters, you will agree, are calculated to remove many misapprehensions with reference to the adoption of electric power by prospective consumers, whose minds may have been prejudiced by those who were unfortunate enough not to obtain sound technical advice when installing their own electrical plant.

C. Rockley.
Publicity Department.

West Ham Corporation Electricity Supply,
February 22nd, 1907.

ELECTRICITY AS MOTIVE POWER.

To the Editor of *Timber Trades Journal*.

Sir,—I wrote to your paper on November 17th, 1906 issue, under the *nom-de-plume* "Disappointed."

Your article in last week's issue, I consider, invites me to give my further experience with the above power. I waited to see if any of your correspondents cared to advise me, and as I did not get any information, I went to the makers of the motor and learned that my plant had not been put down satisfactorily. In the first place, a counter-shaft was in use, and the bench was considerably too near to same, the belts being crossed. This was also pointed out to me as a serious mistake. I was advised to take away the counter-shaft, as it was altogether too heavy, and drive direct from motor to bench, placing the latter 12 to 14 ft. away from the former, and to have an 8-in. pulley on motor with the original 10-in. pulley on bench. I took the advice, with the result that I have cut 12-in. oak and 9-in. spruce quite easily, and 6-in. tariff-boards continuously from 8.30 a.m., until 1 o'clock (when sawyer has an hour for dinner) commencing again at 2 o'clock and finishing at 5.30. With these tests the motor has not become in the least degree over-heated. I have just received my last quarter's account for electricity, and find since the alteration, I have consumed less than half of the power before, and have cut satisfactorily more than five times the amount of timber. I have bought my experience, but am no longer, Yours truly,

"DISAPPOINTED."

An Apprentice Case.

We note in your current issue that you have a report of a case of a man trading as "The Electrical Installation Co.," obtaining money under false pretences. We should like the public to know that our business has nothing whatever to do with the case, and should be glad if you would make this known through your invaluable publication.

The Electrical Installation Co.,
F. H. GALE, *Manager.*

London, W.C., *February 23rd*, 1907.

Electrical Development Association.

With reference to Mr. C. Rockley's letter in your last issue, it may be suggested to meet the difficulty he points out *re* the obtaining of funds, that since an increase of sales resulting from a combined electrical development campaign does not depend in any way on the capital investment of the individual manufacturer, but rather upon his individual activity and the number of orders available, that his contribution must logically be based on his sales. The fairest way to decide the amount is to base it as a percentage on these sales. As undoubtedly in many cases the manufacturer would not care to have the amount of his sales disclosed, an arrangement could be made whereby the auditors of his accounts, would render two certificates to the Association, one for the inspection and satisfaction of other manufacturers, certifying the fact that the manufacturer in question had contributed a certain percentage, and the other for the confidential information of a neutral trusted employé of the Association, certifying the amount that this percentage represented. The total amount contributed in this way would, in turn, be certified by the auditor of the Association, and he would also give a list of the names of the contributing companies.

The municipalities, as well as the lighting companies, should be called upon to contribute to the Association, since they are going to derive benefit from its operations. If it is essential, a way will be found to permit of these contributions being made. From the point of view of the interests of all connected with the electrical industry in any way, all municipalities will have to be stirred up to look for business in somewhat the same energetic way that West Ham is doing to-day. It will be no use to put forward objections to the effect that the Local Government Board or other authorities stand in the way, for if the Association were formed, one of its early duties would be to so arrange matters as to facilitate any legitimate expenditure necessary to the proper development of municipal undertakings.

There are many difficulties to be overcome before an Association such as that described in the ELECTRICAL REVIEW of February 8th can be formed, for it is not easy to get manufacturers and other to look far enough into the future, to sink their individual claims and differences for the sake of a co-operative scheme, even though it is to benefit themselves individually. Notwithstanding this, the scheme seems worth attempting, as the results to be expected are so promising.

R. Borlase Matthews.

Swansea, *February 25th*, 1907.

Metallic Filament Lamps.

I have read the recent correspondence on "Metallic Filament Lamps" with much interest, and the suggestions of a composite carbon and metallic lamp.

But, surely, "A. H. S. C." is not serious when he suggests the alternative of a carbon lamp run in series with a tantalum in a diffusing globe.

If his suggestions are to be taken seriously, I should be glad if he would inform me what advantage his proposed 100-volt tantalum and 120-volt carbon lamps run in series would have over a pair of 110-volt tantalums also in series.

His pair would certainly give less light—in fact, approximately 33 C.P. against 46 for the tantalums. The 20-volt tantalum with 180-volt carbon would be not much better than one carbon lamp of 200 volts.

C. W. G.

Re my reply to "Inquirer," "A. H. S. C.," and Jas. Bastian ask further questions. I will take them in their order

1. "A. H. S. C."—I agree with you in the effects produced when running a tantalum lamp and a carbon lamp in series to a certain extent, but there is not so much gained this way. I understood from "Inquirer's" letter that he intended one lamp containing a "composite" filament, two lamps are a disadvantage when only one is in many cases desired, simply to suit the ordinary every-day fitting.

As to whether the tantalum wire would join itself on to the carbon, I cannot say from experience. The tantalum wire might make sufficient contact. I did not in all cases put in rods of carbon, but put a curl just at the end nearest to the pip of the lamp; therefore, in this instance, the tantalum wire would not be close to the carbon except at the point of contact, *i.e.*, at the joint.

I cannot state definitely that it would enable the tantalum filament to be run on alternating current, but I should say it would not, as I see no reason why the carbon filament should prevent the so-termed crystallisation.

I believe that the two filaments, metal and carbon, being in one bulb do have an effect on each other, and a very important effect. When the metal filament is hot the resistance increases, when the carbon filament gets hot its resistance decreases. Therefore, if tantalum alone is used at the moment of switching on there is a rush of current for an instant, and it decreases as the metal becomes heated; in theory, therefore the continual switching on and off might have a detrimental effect. With a carbon filament, this switching-on does not matter, but when both are used together in series

the high resistance of the carbon acts as a buffer to the tantalum and prevents it receiving so sudden a shock. Again, the proportions may be so arranged that the resistance remains the same when hot or cold. This is a useful combination, and I am using it on this account for quite another purpose. In the reverse direction if the circuit is unsteady or the E.M.F. increases (station engineers tell me it never does) the tantalum resistance rises and protects the carbon in its turn, so they protect each other. The above applies to osmi, &c., as well as tantalum.

2. Mr. Jas. Bastian.—I did not claim it as "my lamp," but gave the names of those to whom the credit is due originally as far as I knew. I cannot answer how I got over the difficulty due to the ageing of carbon and its increased current consumption, because I did not know that this happened in ordinary commercial carbon lamps; my experience and many others' is that a carbon lamp takes less current at the end of its life.

When speaking of the increased current as ageing goes on in metallic filaments, again I did not know it.

I would ask "Inquirer" to state whether Mr. Jas. Bastian or myself has the proper grip of his letter.

I might mention to Mr. Jas. Bastian that these lamps would have been on the market, but for the impossibility of obtaining tantalum. It is no wonderful experiment, but is of good commercial value.

F. Harrison.

London, N., *February 25th*, 1907.

Cost of Gas Power.

Referring to your abstract of Mr. Hugh Campbell's paper on "Suction Gas Engines and Gas Plants" in your current issue, we notice a table giving the comparative cost of working a gas engine and electric motor at Messrs. Croft & Perkins's Works in Bradford, apparently greatly to the advantage of the former. Will Mr. Campbell furnish us with the following additional data in each case:—

1. Capital outlay and amount to be allowed per annum for interest and depreciation thereon.
2. Cost of repairs per annum.
3. Cost of attendance per annum.
4. Cost of water, in the case of the gas engine.
5. Total number of tons of melted metal per annum.

With these data it will then be possible to form a true estimate of the comparative cost of the two methods, for without them the comparison is, of course, misleading.

Walters & Co.

VINCENT E. WALTERS.

Birmingham, *February 25th*, 1907.

A Question of Accountancy.

In your issue of January 25th, 1907, you, in the course of your leading article, say "the general public will have some difficulty in grasping the accounts of the L.C.C." This appears to be true, as the writer of the article has not grasped them, seeing that he has neglected a little amount of about £600,000 profits. This sum has been repaid on account of capital, and would have been distributed as profit, *i.e.*, dividends, if the concern in question was an ordinary public company.

I hope you will investigate this point, and if you find my statement correct, will say so in your journal, as I am a believer in the impartiality of our technical journals, and, moreover, if flaws are found in subjects where we can check you, how are we to know that there are not flaws in subjects where we have to rely upon you as experts?

If this question can be dealt with this week, *i.e.*, before the C.C. Election, I think it should be.

George Webb.

Staines, *February 23rd*, 1907.

[Granted that £600,000 has been repaid, what has that to do with "profits"? Municipal accountants, with rare exceptions, tell us that the sinking fund, to which this sum belongs, takes the place of a depreciation fund, and represents, therefore, the amount by which the value of the assets has decreased. It is as clear as day, therefore, that the so-called "profit" of £600,000 is off-set by a corresponding loss of £600,000. How absurd it is, then, to suggest that this obligatory payment of £600,000 should be held up before the ratepayers as "profit"!

It is simply and solely a payment made to reduce the debt incurred by the construction of the tramways with borrowed money. The number of repayments is arranged to extinguish the debt by the end of the averaged life of the material assets; and if the latter all endured for precisely the period of repayment, or for a longer period, there would be some justification for classing the sinking fund as a depreciation fund. Unfortunately it is not so; a large proportion of the plant will need renewal long before the loan is repaid. The track will require renewal in at most 15 years, much of it in 10 years or less, and therefore a separate depreciation fund must be provided to cover this expenditure. Similarly the rolling stock and much of the generating station plant will be obsolete long before the debt is extinguished. Hence we go further than the municipal accountants quoted above; we say that the sinking fund is far from adequate as a depreciation fund—that *far more* than the stated £600,000 is necessary to provide for the early death of many of the assets. The L.C.C. has, indeed, set aside a sum for the renewal of the tramways; but the Highways Committee has publicly stated that the allowance is insufficient and should be brought up to 1d. per car-mile as soon as possible.

It will be seen, therefore, not only that the £600,000 is *not* profit, but that it falls far short even of covering the inevitable wear and tear of the undertaking. When we add that the undertaking has paid only £153,000 towards the cost of the street widenings which have been and are being carried out mainly for its benefit, and which are estimated to cost £1,256,000, the absurdity of the aforesaid contention will be emphasised.

As for the distribution of dividends, what we have said on the subject of depreciation applies equally to company ownership; indeed, it is even more necessary (though not obligatory) for a company, with limited tenure, to provide against the expiry of its concession, than for a municipality with its ownership in perpetuity.—EDS. E.R.]

U.D.C. Contracts and the L.G.B.

A point which is of particular interest to manufacturers and contractors generally, has been brought prominently before the writer in connection with specifications recently issued by an U.D.C in the northern part of London, for additional plant for their generating station.

In this specification there appears a clause, which is very usual under the circumstances, to the effect that the order placed by the council will be subject to the sanction of the Local Government Board for the loan to meet the expenditure. The official inquiry, which must precede the granting of the loan, has yet to be held, and it is anticipated that at this inquiry strong opposition will be put forward by certain parties who claim that the obligations of the U.D.C. in regard to supply can be met in a more economical manner, and with smaller capital commitments than are now proposed.

In view of the fact that the opposition can contend that the present capital outlay on the undertaking is very large, having regard to its capacity and revenue, it would appear that a strong case can be made out for any proposals which will meet the Councils' obligation to supply at a smaller capital expense than the Councils' proposals, so that altogether there seems to be much room for doubt as to whether the necessary loan will be finally approved.

In a large number of cases the L.G.B. inquiries are not held until some weeks, or even months, after the contractors have received intimation of the acceptance of their tenders, and instructions to proceed, with the result that the contractors may have incurred considerable expense to enable them to keep their promises of delivery to the U.D.C.

The point which the writer wishes to raise concerns the position of the contractor under these circumstances, should sanction for the loan be refused. He must make certain outlays to enable him to keep his promise of delivery to the U.D.C., and it would be interesting to know on whom the responsibility of these outlays should fall. If upon the contractor himself, it appears that the present practice of

placing orders some time in advance of the approval of the loan offers scope for alteration.

I trust you will afford an opportunity of ventilating this matter through your columns; I have no doubt that many readers of the Electrical Review have had occasion to consider the point, and their experience, as also that of your legal contributor, would be of much interest and value to us.

Contractor.

London, *February 18th*, 1907.

[We refer to this matter at length in our leading article to-day.—Eds. E.R.]

LEGAL.

In *re* S. G. Brown's Patent 1,434 of 1899, and in *re* the Patents, Designs and Trade Marks Act. Petition for Revocation.

(*Continued from page* 297.)

On February 15th, Mr. Walter Judd, M.I.E.E., examined by Mr. Graham, said he was a personal friend of Dr. Muirhead, and had been connected for 30 years with submarine telegraphy, and was chief electrician of the Eastern Telegraph Co. and its associated companies, which was the biggest group of associated companies in the world. He had nearly 120,000 miles of cable under his supervision. Relays had been used on land for many years without difficulty, and had been long sought for, for cable work. When Mr. Brown's invention was brought forward he was very favourably impressed with it, and on experiment was satisfied with its operation, which had undoubtedly resulted in saving of time, money and errors. The relays had worked as satisfactorily as one ever expected delicate apparatus to work which required constant supervision, like all their cable apparatus. The royalties his company paid for the use of the instruments would be about £4,000. Dr. Muirhead had submitted a form of relay for him to try in 1899, prior to Mr. Brown's. It had an arm playing between fixed points, and set in vibration by an alternating current; it was tried on the cables at Malta in November, 1899, but was found unsatisfactory, and was not adopted. A later form of Dr. Muirhead's was tried in October, 1900, at Porthcurnow, and at St. Vincent in 1902. These relays had never been used commercially on their cables. In Nov., 1899, they began trials with Mr. Brown's apparatus in Cornwall, and in July, 1900, they began to adopt it. It was subjected to long trials at Gibraltar; the results were satisfactory, and the apparatus was taken over.

Cross-examined by Mr. Walter: They were licensees from Mr. Brown. They used his apparatus purely for re-transmission purposes.

You are using Mr. Brown's apparatus not for the purpose of sending independent signals forward, but certain block signals forward?—The signals we receive.

The interpolator is an apparatus synchronised with the sending apparatus?—Yes; to chop it up, in fact.

It chops up the block signal into its proper number of dots?—Into its constituent parts. We do not use it more than we can help because it is an additional piece of apparatus to look after.

May I take it that normally your re-transmission is by the block signals, though occasionally you use the interpolator?—Yes.

Do you use condensers in working with that both at the sending and the receiving end?—On the relay there are, I think I am right in saying, only condensers in the receiving cross-section circuit.

Have you ever used a magnetic shunt in series with the receiving instrument and the cable annexed to it?—We have used a little inductance at times in various experiments, but I do not think that we have any permanent connection with any inductance of any sort. Very little induction is used in series in the line; no large amount of induction is used in closed circuits with the receiving instrument.

Further cross-examined, the Witness said that they had found that the use of the magnetic shunt in the place of receiving condensers resulted in a considerable gain in speed.

Can you give me any idea of how much?—Something like 10 or 15 per cent. of speed—10 per cent. probably.

Re-examined, the Witness stated that Mr. Brown's instrument was undoubtedly a great advance upon all previous experience.

At the close of the re-examination the hearing was adjourned until Thursday, February 21st.

When the hearing of the petition was resumed, Mr. Sidney George Brown was examined by Mr. Graham, K.C. Witness said he was patentee of 1,434 of 1899, the patent in question. He was a member of the Institution of Electrical Engineers, and was formerly with Messrs. Crompton & Co., electrical engineers, of Chelmsford. About six months before he took out the present patent his attention was directed to telegraphy. He then invented a magnifying relay method for cables exclusively. He went on studying the matter in reference to cables, and in the end he made the invention, the subject of the present patent. One of the things which was absolutely essential in using the relay on cables was the unvarying zero. Witness explained the ordinary way of transmitting signals in a long cable. In transmitting a message, a deflection on one side meant a dot, and a deflection on the other meant a dash. If a siphon recorder was being used it did not much matter whether the received signals were all on the same side of the line or not. By the direction and length of the signals, the man who was reading them could see by the shape of them what was the nature of the transmitted current. The object of the relay was to send the signals on to the section in the same manner as the key was originally operated at the sending end. Therefore it was essential that when a man pressed the key down at the originating station the relay should put the key down for the second section in the same way, and the signal should immediately cease when the operator lifted his finger from the key. It was therefore necessary that the signals should be well defined on the relay. Witness explained the working of the relay, and replying to counsel as to the difficulties of the varying zero, said it was absolutely essential for a signal, or a combination of signals, to get back to the zero before the next signals on the opposite side were recorded. In a siphon recorder, when working the signals, the tongue did not always come back to the zero. It was most essential that if they were proposing to use a relay, they must ensure the tongue coming back to the zero line between each signal. The variable zero that they were troubled with in the present arrangement of the siphon recorder through a condenser was due to the polarising, or charging up, of the receiving condenser; in fact, the impossibility of sending a continuous current through a condenser; therefore, if they were sending a continuation of signals of the same polarity which transmitted a steady current to the condenser, the current eventually died down to nothing. The cable slowly charged up and slowly discharged at a time rate depending upon the resistance and capacity of the cable. This charging up and discharge was independent entirely of the signals that they were attempting to transmit. Coming to the earth currents, another cause of the variable zero, they only came in occasionally when there happened to be earth currents that wished to flow along the cable, and also when there were no currents. Supposing they had not got a condenser, then they would get the full effect of the earth currents on the receiver, which made the signals unreadable. Before his patent, he never saw a shunt used in such a position as had been shown in the specification. Since he invented the shunt, it had come into use in cables, and he and his company were getting considerable royalties from the cable companies. The amount of royalties from the Eastern and associated companies was £4,000; the total was about £7,000.

The Witness was examined on the other invention, which was the drum relay, and said that so far as that part of the mechanism was concerned, they had attained comparative perfection. His drum relay was the revolving drum, which was about 3 in. in diameter, and it revolved about 150 times a minute. If the drum did not revolve, very much stronger currents than cable currents would be required to move the arm. The latter screwed firmly down on the revolving disk gave a good contact, which was most essential. Spring pressure tended to increase the friction at the point. When the drum revolved the tongue moved quite easily in either direction, the friction being abolished. This was, so far as he knew, quite novel at the date of his patent. The general nature of the efforts of earlier inventors to get over the friction was principally the question of vibrating the tongue and making it hammer against the contacts. None were of any value. Dr. Muirhead, the petitioner, tried vibrating the tongue, and two of his recent patents showed the pecking devices. Before his (witness's) patent nobody succeeded in maintaining a fixed zero and in getting over the friction in that way. Claim 2 of Dr. Muirhead's patent of April, 1900, had no resemblance to his revolving apparatus. Dr. Muirhead's Claim 3 had not the slightest resemblance to his.

Cross-examined by Mr. Cripps: In his Claim 2 he had a constant contact with the moving surface. Claim 1 did not include as part of the combination a condenser. He took Claim 1 as a claim without the constant contact and without the condenser. There was no novelty in an instrument of that kind, as regarded the use of a tongue for relay purposes, and so far as regarded making and breaking circuit there would be no novelty. His novelty was in the contact-making device, which reduced the friction by what was called a moving surface. In his view, the words "moving surface" had something to do with rotation.

As an electrician, is there in your view any limitation in the words "moving surface," which would limit them merely to the case where you have a revolving drum to diminish friction?—They would limit them to my specification, naturally.

What do you call the equivalent to the surface of a rotating drum?—A portion of the drum that might revolve, for instance, backwards and forwards.

If instead of having a round surface moving backwards and forwards you had a flat surface moving backwards and forwards, would not that have the same result as regards preventing the friction of which you complain?—I should think it would do so by setting up a vibration upon the tongue.

Would it matter as regards getting rid of friction whether the tongue moved or the surface moved?—It would make all the difference to the performance of the instrument, because it is important that the delicate portion of the apparatus should be undisturbed, except so far as the signalling currents are concerned. His patent would only cover an effective moving surface.

What difference would there be, either electrically or as regards friction, if you held the tongue against a rotating plate tangentially, or if you held it tangentially against the revolving drum?—I do not think there would be any difference. In witness's view, Claim 1 was new when he made it in connection with his specification.

Questioned as to Varley (1862, No. 3,453), Witness stated that he did not think that patentee distinctly stated the contact between a tongue and a revolving drum for the purpose of avoiding friction. It was to prevent the sticking of the relay—that is, the fusing together of the contacts under a very heavy current. The feeble currents Varley referred to were the currents moving the relay, not the currents which were passing the contact.

Was not the purpose for which you had the revolving drum in fig. 8 the same purpose that Varley had it in the specification to which I called your attention?—I think it was just the opposite. I put the drums in to make my contacts; Varley to break them.

What is the difference between Varley's tongue swinging against a rotating drum and your tongue in fig. 8 swinging against a rotating drum?—There is nothing so far as the actual construction of the drum itself and the contact is concerned.

And they were aimed at the same purpose?—They might have been aimed at the same purpose. In witness's invention he would not put any current through without the condenser, and then there would be no risk of fusion. He would get no contact at all without the condensers. His invention was in making an improved contact for the relay, in place of simply breaking the contact as in Varley's.

Therefore the element of invention in your Claim 1 would be the introduction of the condenser?—It is a combination.

Mr. Cripps said he was going to suggest to his Lordship that the condenser was a very old business.

Cross-examination continued: Varley stated that when the line current was weak, to prevent burning at the relay contacts or to lessen it he introduced a condenser; witness did not use the condenser for the same purpose as Varley.

I say that Varley has in every respect the same as you have in Claim 1, for the same purpose, the same aims, and the same results?—I say he applied it to an entirely different purpose to mine. He puts a condenser across the contact to suppress sparking; I do it for an entirely different purpose. I do it to make sparking rather than to suppress it.

Questioned as to Delany, No. 3,839 of 1890, Witness said he could not say whether it was usual at that date to use condensers where one had the polarised relay and the contacts. Delany put the condenser there for the same purpose as Varley rotated the drum, to prevent the welding and the sticking together of the contacts. Delany vibrated the tongue over the surface of the plate; witness did everything he could to prevent vibration being transmitted to his tongue. If one passed a current through a butt contact with very feeble currents at the end of the cable, the contacts were very likely to make no contact at all. There was a film of oxide on the surface of the contact that prevented the current passing. It was found that, by rotating the drum and short-circuiting that with the condenser, the current passed. His patent had reference to long submarine cables, as he had shown in the opening of his specification. He had clearly pointed out the function that the shunt must perform; he had put high self-induction in his shunt for the purpose of forcing the quick-changing currents to flow through his instrument. The low resistance was for letting through what he called slow irregular currents. Witness was then taken to Williams's "Manual of Telegraphy" and the diagram at page 75, where is shown a magnetic shunt with a closed-circuit inductive coil, which, witness said, was to shunt the Post Office relay they had there—the receiving instrument on the landline.

Mr. Cripps, in answer to his Lordship, said the date of that was 1885.

What Mr. Williams calls there "extra currents" are just the same as you call in your specification "slow and irregular currents?"—I do not think so.

Take Williams's instrument used in a relay—is not that exactly the same function as you claim for your magnetic coil or shunt?—No, it is not. The instrument he is shunting with is a line, or magnetic instrument, the Post Office relay. In the case of the cable relay, we have practically no self-induction in the coil to deal with, and therefore we do not require to have an extra current from the magnetic shunt to counteract the action of the receiving coil because we have no self-induction in our relay coil, or practically none. Williams curbs by putting the received current through the instrument, by sharpening the signals that way; my shunt sharpens the signals by separating the slow from the quick.

Re-examined by Mr. Bousfield: So far as regarded the reduction of friction, it really would not matter which they were moving, a plate under a tongue or moving a tongue over a plate so far as the relative movement was concerned. A good many people had worked on the question of a relay by means of which feeble currents should actuate a relay sufficiently to get a good electrical contact in a relay circuit, and, so far as he knew, nobody had, down to 1899, succeeded. In his specification the contact he described was a steady continuous contact. In Varley and the other specifications, he found no suggestion that a condenser should be used for improving a weak contact, or any information, scientific or otherwise, as to the effect of a condenser which would have led him to employ a condenser for the purpose of improving the contacts in figs. 8, 9 and 9A.

Mr. Frank Jacob, examined by Mr. Bousfield, said he had been at electrical work, particularly in regard to the manufacture and working of submarine cables, for some 33 years, and for 27 years had been chief electrician and technical adviser to Siemens Bros., which company had laid eight Atlantic cables, Witness superintending most of the electrical part of all of them. The question of the working of relays at the end of a long cable before the date of Mr. Brown's specification was a matter that was greatly desired among telegraph engineers. He wrote the article on submarine telegraphy in the last edition of the "Encyclopædia Britannica," which was written earlier than 1900. He had no connection with Mr. Brown.

This is only the general statement in your own words:—"A relay capable of working at the end of a long cable has been a desideratum. The difficulty experienced is that of securing a good electrical contact under the very slight pressure obtainable from an instrument, excited by attenuated arrival currents." That is what you wrote?—Yes.

Prior to Brown's specification had that problem, in your opinion, been solved?—No, it had not.

Was there, prior to Brown's arrangement, any practical arrangement by means of which a relay could have been worked at the end of a long submarine cable?—No, not that I know of; I know practically every relay. Witness considered Mr. Brown's a very practical solution—the only one now extant—of the problem of working a relay at the end of a long cable. It certainly struck him as requiring a good deal of invention, because they were all trying to make something of the sort, and never arrived at it. In his view no difficulty would present itself to a practical cable engineer in carrying out a practical installation of Brown's invention from the directions given in his specification.

Cross-examined by Mr. Cripps: They wanted a relay that would send any signals on at all. In his view it did not matter for relay and transmitting purposes whether they had the block signals or whether they reproduced the ripples and curves.

(To be continued.)

Ernest Scott & Mountain, Ltd., *v.* Clark, Stevenson and Co.

On February 15th, at the Newcastle Assizes, before Mr. Justice Lawrance, plaintiffs claimed in respect of goods sold and delivered. It was announced that the parties had agreed, and judgment was entered for the plaintiffs for £130.

Tyler *v.* Power Plant Co., Ltd.

In the Lord Mayor's Court last week, before Mr. Bosanquet, K.C., sitting without a jury, this case was heard. The claim was one brought by Mr. Ralph Tyler, at the time trading as Tyler & Duncan, and now as Tyler & Freeman, to recover damages for breach of contract entered into in the months of May and June, 1905, to supply certain machinery for working a lift at the Royal Victoria Hotel, St. Leonards. The defendants denied that there was any breach of contract or that the plaintiffs had suffered any damage. The defendants raised a counter-claim in respect of certain shares, but that question had not to be gone into because that part of the claim was admitted by the plaintiffs to the extent of £68 odd for calls on certain shares. In addition, the defendants counter-claimed for £95 5s., the price of the machinery which the plaintiffs said was wholly useless and unmerchantable, and which, therefore, they were entitled to reject.

The Common Serjeant gave judgment for the plaintiff on the claim for £119 16s. 9d., and on the counter-claim, except as to the claim for calls amounting to £68 4s., the plaintiffs to have all costs of counter-claim except such costs of and occasioned by the part of the counter-claim which had been admitted.

"Agincourt" S.S. Co. *v.* The Eastern Extension and Australasia and China Telegraph Co., Ltd., and the Great Northern Telegraph Co., Ltd.

On Thursday last week in the King's Bench Division of the High Court, Mr. Justice Bray had before him the above case, which was an action for alleged breach of contract, owing to which plaintiffs claimed compensation for sacrifice of ship's material.

Plaintiffs are owners of the ss. *Agincourt*, and defendants are owners of certain submarine telegraph cables, and plaintiffs' case was that the defendants laid cables in the bed of the River Yangtse Kiang in the neighbourhood of Woosung in China. With a view to preserving these telegraph cables from injury in the event of their being fouled by vessels, on August, 1902, a notice signed by the joint manager of the defendants' company was issued, promising to compensate owners of ships who would be able to prove that they had sacrificed their anchors in order to avoid injuring the submarine cables. In September, 1905, owing to indications of a typhoon, the *Agincourt* weighed anchor, and it was found to be foul of one of these cables. Relying on the defendants' notice, the master of the *Agincourt* sacrificed his anchors, and incurred other loss. It was also alleged by plaintiffs that the cables created an obstruction to navigation, and they gave no warning to vessels by means of buoys, lights or charts.

Defendants denied that they were joint owners with their co-defendants of the telegraph cables referred to; they denied that they jointly laid the cables, or that the cables constituted an obstruction, but said that they were laid and maintained under an agreement with the China Telegraph Administration. Defendants further alleged that they distributed charts showing the position

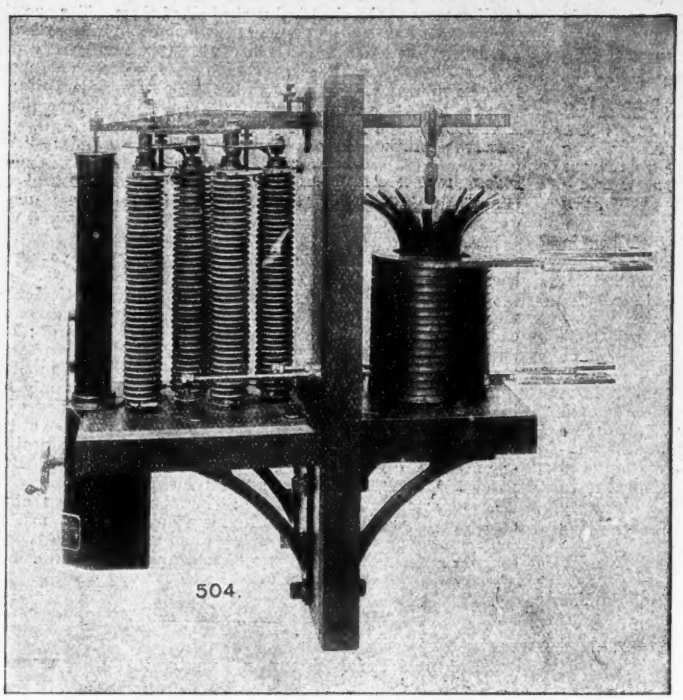


Fig. 1.—The Carbon Regulator used with the Entz Booster.

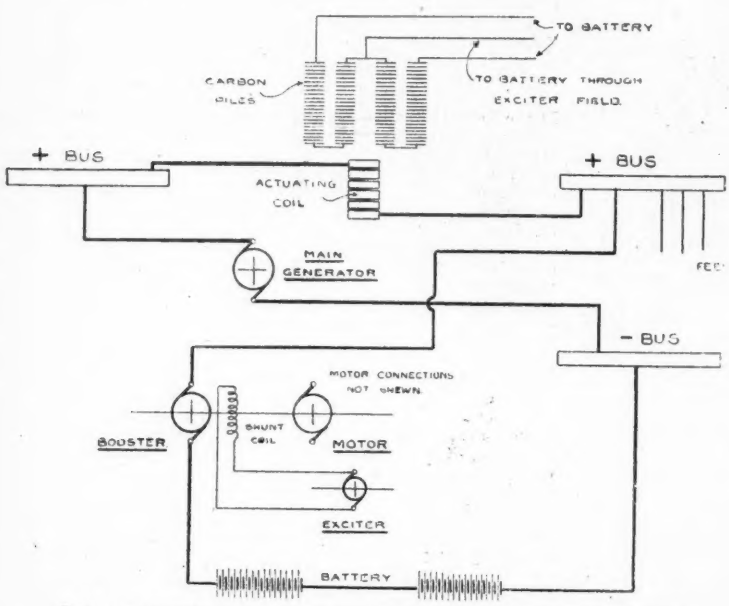


Fig. 2.—Showing the Electrical Connections of the Entz Booster.

occupies about the same space on the switchboard as an ordinary watt-hour meter. The regulator itself consists of a number of piles of carbon disks, which are subjected to the varying pressure of a lever. From one end of this lever is freely suspended the soft-iron core of a solenoid which carries the entire generator load, while to the other end is attached a helical spring, whose tension may be adjusted by hand to counterbalance the pull of the solenoid at any desired load on the machines. Slight variations of load above or below this amount will cause changes in pressure on the carbon piles, resulting in wide variations in their contact resistance. Advantage is taken of this resistance variation to control the field excitation of the battery booster, usually through the intermediary of a small exciter, between whose fields and the carbon piles connections are made similar to those of a Wheatstone bridge, the current in the exciter fields varying in direction and amount with changes in the pressure on the carbon piles.

The arrangement of connections is shown diagrammatically in fig. 2. It will be seen that the + bus-bar is divided, and a series regulating coil carrying the main current is inserted. The battery is connected across the mains in series with the armature of the booster, which has a single set of field coils separately excited. In some cases the exciter is driven by a chain from the booster set, but a separate motor is more frequently employed.

The constant load on the generators may be adjusted to any desired value by adjusting the tension of the spring above mentioned. The battery may either "float" or take a continuous peak discharge, or a net charge, according to the adjustment, while always taking automatically the momentary fluctuations of load. The carbon regulator responds to very small changes in the generator load, and the sensitiveness of the regulator is as great under heavy load conditions (when close regulation is most important) as at times of lighter loads, a result which it is difficult to secure in cases where the field windings have to be shunted with increasing load.

The action of the lever on the carbons is limited in either direction by adjustable mechanical stops, which may be set to limit the battery charge and discharge to any pre-determined maximum. When this limit is reached, any further swing of the load will fall on the generators. The booster is thus protected against excessive overloads at times of abnormal fluctuations, by bringing into service the overload capacity of the generators without opening the battery circuit-breaker, while sensitiveness of regulation under normal conditions is not impaired. This is an important feature of this method of control, eliminating as it does the annoyance incidental to the opening of the battery circuit-breaker on overload, which almost invariably results in a destructive load on the machines or the opening of their breakers and the consequent total interruption of power on the line.

From the electricity works of the Greenock Corporation energy is supplied to the Greenock and Port Glasgow Tramways Co. To deal with this load there are installed two generators of 300 kw. and two of 180 kw., and a battery of 260 CW8 type Chloride cells, rated at 286 amperes for three hours. The recording ammeter diagram, fig. 3, shows the heavy fluctuations of the line load, while the remarkable steadiness of the bus-bar voltage is clearly demonstrated in the upper part of the same figure, which is a photographic reproduction of the actual chart.

The Chloride Electrical Storage Co. inform us that they have recently received from Mr. J. A. Robertson, M.I.E.E., the burgh electrical engineer, figures dealing with the coal consumption per unit at the Greenock Corporation Electricity Works, for the nine months ending September 30th, 1905, and for the same period of 1906. During the latter period the "Entz" shunt regulating type of booster, fig. 4, and Chloride accumulator plant was working in connection with the traction system. The comparison is very striking. For the nine months ending September 30th, 1905, when the booster battery plant was not installed, the consumption was 8·20 lb. of coal per unit (lighting and traction) delivered from the switchboard. For the same period of 1906 the corresponding figure was 6·56 lb., or a reduction of 20 per cent., which is equivalent in this case to a saving of about 2,146 tons per annum.

of the cables, but did not indicate the position by means of buoys or lights.

His Lordship held that the plaintiffs were entitled to be compensated from the Eastern Extension Telegraph Co. for loss of their anchor and chain, and damage which naturally flowed therefrom.

THE "ENTZ" BOOSTER.

In our issue of August 3rd last year, we mentioned that the "Entz" reversible booster was in use at the Greenock electricity works, in conjunction with a Chloride traction storage battery, and had exerted a remarkable influence on the coal consumption. We have now received from the Chloride Electrical Storage Co., Ltd., who have introduced the apparatus into this country, further particulars as to its construction and performance.

The chief feature in connection with the apparatus is the carbon regulator, shown in fig. 1. This is a neat and compact device, and

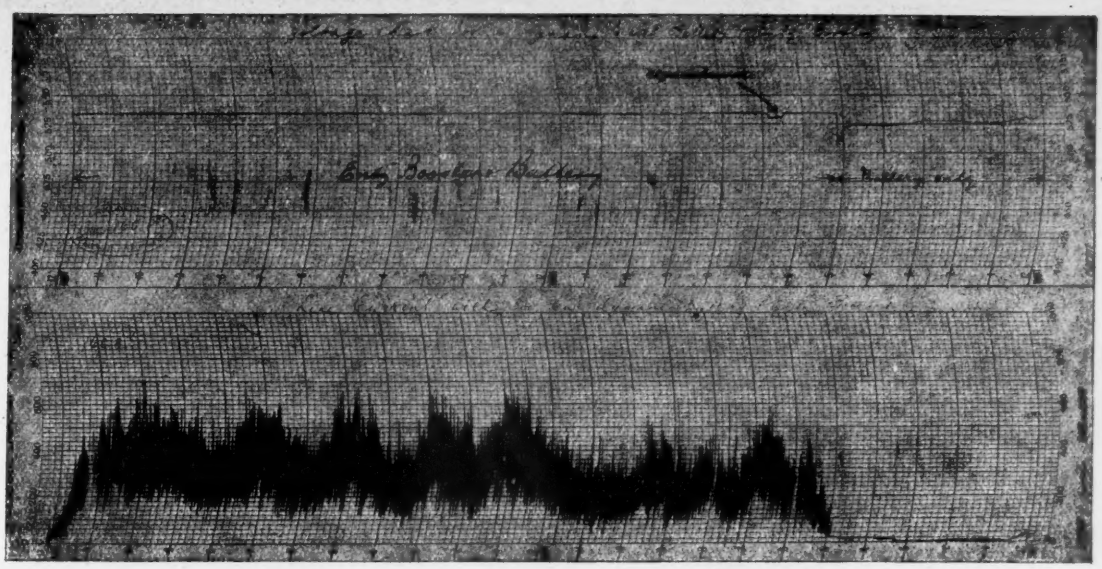


Fig. 3.—Photographic Reproduction of Greenock Load Curves, with the Entz Booster Equipment.

The traction output amounts to only about 30 per cent. of the total output, yet, by installing the booster-battery plant on the traction system, a 20 per cent. saving on the total coal consumption has been brought about. It has also been possible to run with 33 per cent. less generating plant, although the maximum traction load has increased. Mr. Robertson attributes the diminution in the coal consumption almost wholly to the use of the battery and the Entz automatic booster, and states that, in addition to this, an appreciable saving has been effected in the wear and tear of the engines used for traction purposes.

The cost of a complete "Entz" booster-battery equipment for dealing effectively with a fluctuating demand is, as a rule, considerably less than that of boilers, engines and dynamos of corresponding output; thus not only is capital expenditure kept down, but economies are realised which will generally reimburse the total outlay for the equipment within three or four years.

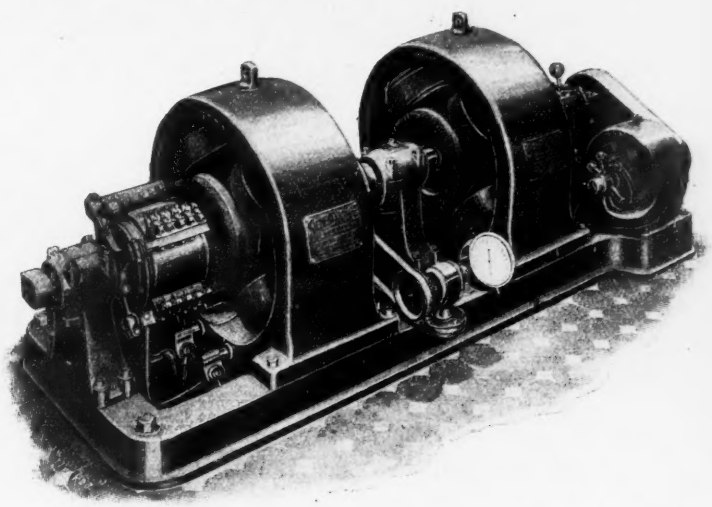


Fig. 4.—The Entz Reversible Booster, Greenock Electricity Works.

PARLIAMENTARY.

Private Bills in Parliament.—On Thursday last week the Examiners, Messrs. Campion and Jeune, had before them a number of Bills for compliance as to Standing Orders, and the following, among others, were ordered to go forward:—London & North-Western Railway Bill, London & North-Western Railway (Superannuation Fund) Bill, the Richmond (Surrey) Electricity Supply Bill, the Plymouth and North Devon Direct Railway (Abandonment) Bill, and the Shanklin Gas Bill. The consideration of the Barnsley, Wombwell and Wath Tramways Bill was postponed until February 28th.

On Friday the Examiners of the House of Lords ordered the following Bills, among others, to go forward:—West Yorkshire Tramways, Oxford & District Tramways, Folkestone, Sandgate and Hythe Tramways, and the Metropolitan Railway (Pension Fund).

Telephone Extension.—Answering Mr. Courthope in the Parliamentary Papers, Mr. Sydney Buxton states that he will be glad to establish a telephone service in Robertsbridge, Sussex, if the necessary support is forthcoming. Estimates in respect of the extension are being prepared.

Petitions.—Nine further petitions have been deposited in the Private Bill Office of the House of Lords against the Barnsley, Wombwell and Wath Tramways, including those of the West Riding County Council, the Yorkshire Electric Power Co., and the Great Central Railway. Four further petitions are deposited against the Oxford and District Tramways, amongst them being the Oxford Electric Co. and the City of Oxford and District Tramways Co. The Sheffield Corporation Bill is being opposed by 14 petitioners, including the Yorkshire Electric Power Co.

BUSINESS NOTES.

Condensing Plant Contracts.—The Mirrlees Watson Co., Ltd., of Glasgow, have just received the following list of important orders for condensing plant:—

Surface Condensing Plants.—For Birkmyre Bros., Calcutta (per the British Westinghouse Co., Ltd.). Repeat order, third set; duty, 26,250 lb. steam per hour. For the Mexborough Tramways (per the National Electric Construction Co., Ltd.); duty, 15,000 lb. steam per hour. For the Greenock Corporation; repeat order; duty, 30,000 lb. steam per hour.

Sub-base Surface Condensing Plant.—For the British Thomson-Houston Co., Ltd. Duty, 37,000 lb. steam per hour.

Low Level Counter-current Jet Condensing Plant.—For Alexander Cross and Sons, Ltd. Duty, 8,250 lb. steam per hour.

Advance in Swiss Prices.—The disproportion which has arisen between the cost of raw materials, particularly copper, and that of producing manufactures, in consequence of the general and continual rise in the price of the former, has induced the following Swiss firms to increase rates by 15 per cent.:—The Oerlikon Engineering Works; Brown, Boveri & Co.; G. Meidinger & Co., of Basle; the Compagnie de l'Industrie Electrique et Mecanique, of Geneva; Sprecher & Schuh, of Aarau; the Alioth Electricity Co., of Munchenstein-Basle; C. Wuest & Co., of Seebach-Zurich; Gmur and Co., of Schanis; and A. Zellweger & Co., of Uster. The increase relates to switches, safety appliances, resistances and heating apparatus, with the exception of measuring instruments and apparatus for weak currents.

Installation Contracts.—The Bradford Electrical Engineering Co. have received the following installation contracts:—Electric lighting of the Bradford Original Al Fresco Pavilion and Gardens; electric light installation, telephones, bells, engine and dynamo, accumulators, &c., for country house, The Oaks, Scotton, Yorkshire; electric lighting, &c., for the Rudge Whitworth, Ltd., New Depôt, Bradford.

Trade Announcements.—As considerable confusion appears to exist as to the relationship between Messrs. Rolls-Royce, Ltd., motor-car manufacturers, and Messrs. Royce, Ltd., we are asked to explain that Messrs. Rolls-Royce, Ltd., have taken over the automobile business inaugurated and formerly carried on by Messrs Royce, Ltd., at Cooke Street, Hulme, Manchester, where they are continuing the manufacture of the well-known "Rolls-Royce" motor chassis. Messrs. Royce's offices and works, which have been considerably enlarged to meet the re-arrangement, are situate at Trafford Park, Manchester (now their only Manchester address), and they are there continuing the manufacture of the "Royce" dynamo-generators, electro-motors, motor starting and controlling switches, switchboards, arc lamps and accessories, and the well-known "Royce" electrically-driven cranes, hoists, capstans, winches, and transporters. The two firms are totally distinct and separate companies, Messrs. Rolls-Royce, Ltd., manufacturing motor-cars, and Messrs. Royce electrical plant, cranes, hoists, &c.

In view of increased business, Messrs. Julius Sax & Co., Ltd., have secured larger premises, and on and after March 7th, their new address will be 100, Charing Cross Road, W.C., where they will have showrooms in which to exhibit a complete and varied range of electrical apparatus.

Messrs. Ward & Goldstone have now removed to their extensive and imposing new factory at Springfield Lane, Salford, Manchester. The new works are equipped with the latest labour-saving machinery, and a suction gas plant has been installed for driving purposes. The firm's wire-covering machinery has been largely added to, and is now capable of supplying from 25 to 35 tons of insulated motor and dynamo wires weekly. Messrs. Ward and Goldstone have also laid themselves out for every description of iron-clad work, such as iron-clad fittings, switches, fuse-boards, &c.

The Falkirk Iron Co. have recently completed, at their works at Falkirk, a fine dispatch warehouse, 300 ft. long × 100 ft. wide, with four lines of rails and two island platforms each 300 ft. long × 27 ft. wide. Accommodation is provided for over 50 wagons. This large addition to the dispatch department will afford greatly increased facilities for the rapid dispatch of goods and prompt execution of orders, enabling the company to send away 50 wagons daily, and by working double shifts, 100 wagons. Besides this, the storing accommodation is again considerably added to, and much larger stocks are now able to be kept. A complete system of tramway rails all over the works adds to the convenient and rapid transit of goods from the various departments to the loading shed. At their London warehouse the company have recently completed greatly improved and extended showrooms for the more effective display of all the new and up-to-date designs and models of the many varieties of goods which they manufacture. Special arrangements have been made with the railway companies for the express delivery direct from works of goods for the southern and western and other districts of England; this, with the largely increased stocks at Falkirk, will ensure prompt delivery of goods selected from the London showrooms.

Messrs. Newtons, Ltd., of Taunton, have appointed Messrs. James Gray & Co, of 212, St. Vincent Street, Glasgow, as their sole representatives in the West of Scotland. Messrs. Gray & Co. have had considerable experience with their machines. Messrs. Newtons' East of Scotland representative is Mr. T. McEwan, of 9, Clyde Street, Edinburgh, and a stock of their machines is kept at this address, and also at the London office, 86, Charing Cross Road (Messrs. Baxter & Caunter), and at Manchester, where their agents are Messrs. Generators, Ltd., of 79, Corporation Street. Other agency arrangements are under consideration.

The new London electric fittings showroom of Messrs. H. W. Sambidge & Son, Ltd., to which we made a brief reference in our last issue, is at Cecil House, 57a, Holborn Viaduct, E.C., and Mr. W. H. Edwards is the firm's representative there.

Mr. Frank T. Hanks, for the last 16 years with Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, has taken up the sole agency of the Adams Manufacturing Co., Ltd., for the sale of their "Igranic" motor controlling apparatus in Newcastle and the North-Eastern district. His address from to-day will be 1, Higham Place, Newcastle-on-Tyne, and his telephone No. 3,069 Central.

Reyrolle Fuses.—We regret to learn that an error occurred in our note on Messrs. Reyrolle's H.T. tubular fuses in our issue for February 22nd. The capacity of the fuse is given as 50 amperes at 600 volts, instead of 6,000 volts, as it should have been.

Annual Dinner.—The staff of The General Electric Co, Ltd., Newcastle-on-Tyne branch, held their second annual dinner and smoking concert on Friday, February 15th, at the Emmerson Restaurant, Newcastle-on-Tyne. A large number of visitors were present, and both the dinner and concert proved a great success. Mr. J. Spence, branch manager, was chairman.

Bankruptcy Proceedings.—F. B. Nicholson.—Under this failure the first meeting of creditors was held last week at the London Bankruptcy Court, before Mr. G. W. Chapman, Official Receiver. It appeared that the debtor started in business about eight years ago as a contractor for electrical work at 52, Victoria Street, under his own name, and without capital. Three months afterwards he took in a Mr. De Winton as a partner, that gentleman providing about £600. The partnership was dissolved a year later; Mr. De Winton's capital was repaid in full, and the debtor continued the business until November 22nd, 1904, when he converted it into a limited company, registered as Nicholson and Robinson, Ltd. Mr. Robinson was in the same line of business, and had a good connection. He subscribed for £200 worth of shares, whilst the debtor took one share, and was appointed managing director jointly with Mr. Robinson. His wife, however, took up £800 odd of the shares, 1,026 being issued altogether. The company carried on a good business until June, 1906, when possession was taken on behalf of Mr. Joseph Russell, a debenture-holder for £550, and a Receiver and manager was appointed in the person of Mr. A. B. Russell, 11, Ludgate Hill, E.C. At the time of such appointment, certain interest on the bonds and a part of the principal remained unpaid. The Receiver was still in possession, and the debtor had since done nothing. He states that he owes about £300, and has assets to the value of about £200. The petitioning creditor's debt is in respect of a photographic business in which the debtor was a sleeping partner. He attributes his failure to such liability, to loss of position as manager of Nicholson and Robinson, Ltd., and to want of capital. The meeting was adjourned for three weeks to give the debtor an opportunity of submitting an offer to the creditors.

R. O. Thompson, electrical engineer, Freshfield Road, Brighton.—A first and final dividend of 2s. 9d. is payable from to-day. Official Receiver, 4, Pavilion Buildings, Brighton.

Books Received.—"The Commercial Organisation of Engineering Factories." By H. Spencer. London: E. and F. N. Spon, Ltd. 1907. 10s. 6d. net.

"Long-Distance Electric Power Transmission." By R. W. Hutchinson, jun. London: E. and F. N. Spon, Ltd.; New York: D. Van Nostrand Co. 1907. 12s. 6d. net.

"Modern Steam Engineering in Theory and Practice." By G. D. Hiscox. With chapters on Electrical Engineering by N. Harrison. London: Crosby Lockwood & Son; New York: Norman W. Henley Publishing Co. 1907. 12s. 6d. net.

"La Moderna Teoria dei Fenomeni Fisici." By A. Righi. "La Ionizzazione e La Convezione Elettrica nei Gas." By L. Amaduzzi. Bologna: Ditta Nicola Zanichelli. 1907. Price 5 lire each.

"The Record of the Special Commission formed by the British Fire Prevention Committee to visit the Principal Cities of Italy on the occasion of the International Fire Service Congress at Milan, 1906." London: The Committee, 1907. Price 5s.

Dissolutions and Liquidations.—Mason & Brown, electricians, Leicester.—Messrs. C. T. Mason & S. R. Brown have dissolved partnership. Mr. Brown attends to debts.

Britannia Electric Lamp Works, Ltd.—This company having disposed of its business to the Britannia Electric Lamp Works (1905), Ltd., has resolved upon voluntary liquidation, with Mr. S. B. Worley as liquidator.

Deep Leads Electric Transmission Co., Ltd.—The petition of Victorian Deep Leads, Ltd., and others for the winding up of the above company was mentioned before Mr. Justice Parker on Tuesday. Mr. Rosser, K.C., said the parties had arrived at a settlement of their difficulties. The matter had been reduced to writing, but the agreement had not been executed. The petition accordingly stood over with a view to being finally arranged.

Jenatzy Patent Underframe.—We have received particulars of the Jenatzy patent suspension for lorries and commercial vehicles, from Messrs. H. M. Hobson, Ltd., of 29, Vauxhall Bridge Road, S.W. The invention consists mainly in mounting the mechanical part of the vehicle as a whole upon a second frame, entirely independent of the vehicle frame, and suspended from the latter by special springs. Thanks to this arrangement, the driving mechanism is entirely suspended on springs, and the absorption of vibrations and shocks no longer depends upon the load which the vehicle is carrying, so that the mechanism is thoroughly protected.

Catalogues and Lists.—The Electrical Co., Ltd., Charing Cross Road, W.C.—Leaflet giving prices and particulars of their small continuous and alternating-current motors, also special piano motors and suspension motors for dentists, massage apparatus, &c. A second leaflet describes the construction, working and adaptability of the "Blackmore" patent remote control switch for central stations, contractors, &c., and gives prices. We understand that the company is making this type of switch for alternating-current, and change-over switches which are now under construction, will soon be put on the market.

Messrs. Crompton & Co., Ltd., Salisbury House, E.C.—28 pp. illustrated pamphlet in their standard form and of their usual size for filing, giving very full information concerning their switchgear work. The switches, cut-outs and accessories here described have been specially designed by the firm for central station switchboard service. A half-tone view of a power and lighting board supplied to H.M. Dockyard at Devonport is shown, and other illustrations appear of a board supplied to Falmouth electricity works, a power and lighting switchboard supplied to the Royal Small Arms Factory at Ishapur, and a board with generator, battery and booster panels. Line diagrams and price details are given.

Messrs. Clarke, Chapman & Co, Ltd., Victoria Works, Gateshead-on-Tyne.—New pamphlet of 34 pages, giving useful information concerning their colliery power plant. In this line the firm's manufactures cover practically the whole field, for they include water-tube boilers, feed pumps, high-speed engines, condensers, electric generators, switchboards, winding and haulage gears, three-throw pumps, coke-quenching pumps, &c., so it can easily be understood that in so small a pamphlet only enough can be published to indicate the fact that these are the lines with which they deal. Tables giving current carried by different sizes of wire and cable, wire-rope strength, horse-power of motors for main and tail and endless rope haulage work, also other data in tabulated form, are accompanied by some typical half-tone views of Clarke-Chapman manufactures.

Messrs. Alfred Herbert, Ltd., Coventry.—New catalogue (section E5, first edition) just issued, containing full description and excellent half-tone illustrations of the firm's combination turret lathes. A number of pages are taken up with particulars of standard tool outfits for these lathes and illustrations of samples of work produced on them.

Ateliers de Constructions Electriques de Charleroi, Charleroi, Belgium.—Illustrated pamphlet containing full description in English of Heyland's patent single-phase induction motors, with diagrams of connections and dimensions and tabulated technical and price data. A second pamphlet contains a quite imposing list of firms and others in this country who have purchased or are using the Heyland motors. Particulars of the motors supplied in each case are given.

Otto Biland, St. Imier, Switzerland.—Leaflets relating to, and illustrating, revolution counters, non-magnetic chronographs and chronoscopes, non-magnetic watches, &c.

Kueppers Metallwerke, Ltd., Bonn (agent in United Kingdom, G. Feldt, 50-51, Fore Street, E.C.).—Several English circulars relating to "Tinol," directions for using it, prices per lb., &c.

Messrs. Stöcker & Co., Leipzig.—Catalogue (stiff binding, 140 pp.) giving numerous illustrations of their various telephone and telegraph apparatus and accessories. The names of articles, reference numbers, prices, and so forth are concisely arranged in table form throughout. The contents include bells, pushes, art-metal plate-work, contacts, indicators, telephone instruments of the desk, wall and other types, street telephone boxes, telegraph apparatus, batteries, electro-medical apparatus, and various sundries.

Elektrotechnische Industrie, Slikkerveer, Holland.—Folding list, showing illustrations of their dynamos and motors, motor-generators, transformers, &c.

Messrs. Michael Pal & Co., Parliament Mansions, Victoria Street, S.W.—Leaflet illustrating and describing their electric tool-grinding and polishing machine.

Messrs. F. E Emerson & Sons [Victoria Electrical Works] 7, Broken Wharf, Upper Thames Street, E.C.—New trade list (60 pp.) containing illustrations and prices of electric bell pushes, indicators, contacts, switches, fuseboards, &c.

Edison & Swan United Electric Light Co., Ltd., London, E.C.—New leaflet, No. 2,083, dealing with their new and improved forms of moving-coil instruments. All the types listed are guaranteed for absolute accuracy to within 1 per cent., and if necessary for special purposes they can be calibrated and guaranteed to within one-fifth of 1 per cent. The instruments are all of the dead-beat type. A special form consists in the new type of moving-iron instruments recently brought out by the firm. These are specially suited for motor work, and at a small extra cost can be calibrated to read direct in horse-power. They are sector shape, and can be arranged for either front or back connections. The cast-iron case is of specially fine grain metal, relieved with nickel facings. A point of importance in saw-mills and places of a similar nature is that they are dust proof.

Reduction of Capital.—Diesel Engine Co., Ltd. and Reduced.—A petition for confirming the reduction of the capital from £500,000 to £137,500 is to be heard in London on March 12th.

Waldorf Hotel Switches.—Messrs. J. H. Tucker and Co. have obtained the order for the whole of the switches fitted in "O.C." patent flush boxes for the Waldorf Hotel, London. These boxes have been designed by an engineer for the purpose of simplifying flush work, and they are claimed to save considerable time in fixing and wiring.

Hounslow Exhibition.—We omitted to mention in our brief note on this exhibition last week that the Dowsing Radiant Heat Co. had an extensive exhibit of their heating and electro-medical apparatus. The room specially set apart for demonstrating the uses of the latter formed quite an attraction to visitors. We understand that the closing of the exhibition was postponed until Saturday, the 23rd ult.

LIGHTING and POWER NOTES.

Ascot.—At a meeting of the Ascot Gas and Electricity Co. held in London last week, the chairman said that arrangements were being made to erect an electric lighting plant in the near future, and in this matter the directors were moving with the greatest caution.

Bath.—We understand that the Corporation has decided, by 41 votes to 2, to sell its electricity undertaking to the Somerset and District Electric Power Co., subject to the sanction of the B. of T.

Bexhill.—The T.C. has decided to extend the plant at the electricity works at a cost of £5,700, made up as follows:—A 500-kw. generator, £3,100; boiler, £1,700; pipe work, £500; other work, £400.

Birmingham. — The Electric Supply Committee's report to be presented at the next meeting of the City Council, states that there is every probability that the cost of generation in the Summer Lane station, will be materially less than in the other stations. The sub-stations in Camden Street, Court Road and Scholefield Street have now been completed. The continual increase in supply has necessitated considerable extensions of mains, especially in the Summer Lane, Balsall Heath and Bordesley districts. The sum of £7,378 has been expended over loans authorised, in consequence of this, and as an expenditure of about £70,000 is estimated during the next three years on mains, the Committee has recommended that application be made to the L.G.B. for sanction to a loan of £80,000 to cover these amounts.

Canada.—Toronto.—The Toronto Electric Light Co. is applying to the Ontario Legislature for authority to increase its capital stock by $1,000,000, thus making the total capitalisation $4,000,000. The necessity for this increase is explained by the fact that large extensions to the present plant are urgently needed in order to keep pace with the rapid growth of the city. It is the intention of the company in the coming spring to erect two new sub-stations in the city, and, in addition, to lay in the near future about seven miles of underground mains. A contract for mains costing $32,000 has already been signed. The company is now taking a regular supply of energy from Niagara to the extent of 2,500 h.p.

The City Council has opposed the application of the company to be allowed to increase its capital, and the Provincial Secretary has reserved the whole question for the Lieut.-Governor of Ontario in Council to decide. The city's contention was that steps were now being taken under the Government's legislation to make a contract for electric power supply from Niagara Falls, and it was also intended to ask the Legislature to pass a Bill allowing the city to expropriate the company's plant. The increase of capital would be an embarrassment to the city at the present time, and it would prefer that matters remain in *statu quo*. The company states that the additional capital is required to enable it to properly handle the energy being delivered from Niagara, and that on the strength of the belief that the new issue would be authorised, a number of new contracts have been made. Representatives of the city and the lighting company attended by their counsel recently attended before the Provincial Secretary and fully argued the case before him.

It is anticipated that the company's application will be held over until the fate of the city's Bill is decided or the Government's new Companies' Act is passed, under which new issues of capital can only be made with due regard to stringent restrictions.

The Toronto municipality has decided to use electrical energy from Niagara to operate the septic tank and bacteria bed sewerage system. The city engineer has made arrangements with the Toronto Electric Light Co. for a supply of power until the municipal system is installed.

Hamilton.—A committee has been appointed to obtain an estimate of the cost of a municipal plant.

Westmount. — The Canadian General Electric Co. has recently installed 150 magnetite arc lamps in this town for street lighting.

Cardiff.—The Albion Products Co. recently inquired of the E.L. and Tramways Committee what rate would be charged for a supply of electricity for the manufacture of carbide of calcium. They stated that they had three factories on the Continent and in America, and were desirous of starting factories here if electrical energy could be obtained at a sufficiently low rate to enable the works to compete with the cheap water-power of Norway, Switzerland and Italy. Mr. Arthur Ellis stated that the company would require 200 to 400 h.p., and he suggested that the same terms be offered them as had been offered to the Cardiff Railway Co. and the Ely Paper Works, with a minimum of ⅝d. per unit.

Carmarthen.—Having decided that it is desirable to light the town by electricity provided a suitable scheme is obtained, the T.C. has appointed a committee to inspect the installation at Penarth.

Coventry.—A visit has recently been paid to Coventry by Major Cardew, of Messrs. Preece & Cardew, in order to advise the Corporation E.L. Committee upon proposed extensions to the undertaking.

Devonport.—The *Western Morning News* states that the electrification of the lighting system at the Naval Ordnance Depôt has been completed. The plant was supplied by three firms — the Lancashire Dynamo and Motor Co., generating plant with Willans engines; Messrs. Henley's Telegraph Works Co., the main cables and junction boxes; and Messrs. Corse & Co., Plymouth, the incandescent and arc lighting. It has now been decided to extend the application of electricity to the cranes used for loading and unloading vessels at the pierheads, and plans and estimates for electric motors and gear have been approved by the Admiralty. The plans provide for the retention of the existing cranes, which are of comparatively recent design, with the addition of platforms and gearing to adapt them for the attachment of the hoisting and traversing motors. Each crane is to be provided with two electric motors, one of 10 h.p. for hoisting purposes and one of 5 h.p. for traversing.

Dundee.—The Electricity Committee has considered the report of Mr. J. F. C. Snell, favouring the erection of a new station at Stannergate, the retention of the present works in Dudhope Crescent Road as an auxiliary station, and the erection of sub-stations. Mr. Don submitted a modification of the scheme outlined by Mr. Snell and mentioned last week, involving an outlay of £50,000. This will meet immediate requirements, and as necessity arises, the full scheme can be eventually carried out. The Committee approved of this latter proposition which is practically what

Mr. H. Richardson, the burgh electrical engineer, recommended some time ago. The Council is to be asked to approve of the Committee's decision, and in the meantime a sub-committee is to negotiate with the Harbour trustees for a site at Stannergate.

Dublin.—The Corporation is about to extend the plant at the Pigeon House Fort, by the addition of a 1,500-KW. turbo-generator set.

Eccles.—The T.C. proposes to extend the plant at its electricity works. A reduction in the price of electrical energy is to be made in April next.

Edinburgh.—The E.L. Committee has recommended the acceptance of estimates amounting to upwards of £10 000 for new condensing plant at the M'Donald Road generating station and £130,000 for generating plant. The new plant, it is expected, will meet the demand of the department for two winters.

Enfield.—On Saturday, the 16th ult., the inauguration of the electric supply in this growing locality took place, the chairman of the Urban District Council, Mr. D. Weston, J.P., officiating. The Enfield Electricity Works is one of the series of sub-stations supplied by the North Metropolitan Electrical Power Distribution Co., from its Brimsdown power station, some three miles away, or alternately from the same company's station at Willesden. The buildings comprise machine and battery rooms, offices, &c.; the primary supply is three-phase alternating current at 10,000 volts and 50 cycles, and this is transformed and distributed as direct current at 240 volts for lighting and 480 volts for motors larger than 2 H.P. The plant installed includes two B.T.-H. 10,000/400-volt step-down transformers supplying two 100-KW. motor-generators by the same firm; a 250-cell Tudor accumulator and B.T.-H. booster are also installed, all the plant being controlled by B.T.-H. switchgear—the H.T. panels and plant arranged on one side of the building, and the L.T. panels and booster on the other. Space is available for four more motor-generators of larger sizes, when extensions are required. Some 15 miles of feeders and distributors have been laid, and since September last 2,500 8-C.P. lamps have been connected up. In connection with the opening, a display of lighting, heating and power plant was on view at the works. The North Metropolitan Electrical Power Distribution Co., who hold the provisional order for the area, supply energy for lighting at 7d. and 2d. per unit, maximum demand, or 1s. 3d. for each 8-C.P. lamp alight, and 2d. per unit; for power, 4d. and 1d. per unit, maximum demand, or 1½d. per unit during daylight hours only.

Gravesend.—An inaugural ceremony will be performed by the Mayor on the 6th inst. in connection with the opening of extensions at the Corporation electricity works.

Huddersfield.—The borough treasurer's statement relating to the working of the electricity department for the year ended December last shows the income to have been £27,924; working expenditure, £17,217. Financial charges absorb £9,940, thus leaving a net surplus of £767, which has been placed to depreciation account.

India.—CALCUTTA.—The number of units delivered to consumers during the four weeks ended January 25th last amounted to 341,205, compared with 274,128 units in the corresponding four weeks of 1906.

London.—ST. PANCRAS.—The General Purposes Committee reported to the B.C. on Monday last that it had been approached by Messrs. Parsons & Co., who had intimated that Messrs. Siemens Bros. remarked that the dynamos supplied by them with No. 2 generator set to the Council were designed when the practical results now available were little known, and that they, therefore, felt, in the interests of all parties, that they would like to embody in the machines the latest theoretical and practical experience available. Messrs. Parsons & Co. submitted the following as the alterations proposed to be carried out by Messrs. Siemens Bros.:—(*a*) The substitution of their new ventilated commutators (external blower not necessary with this type); (*b*) the addition of compensating windings to the fields. The chief electrical engineer reported that Messrs. Siemens Bros.' representative had informed him that the firm also intended to rearrange the windings of the armatures, but this proposition seemed to have been omitted from Messrs. Parsons' communication. He suggested that the Council should accept the offer, adding that if Messrs. Siemens Bros. when putting on the new commutators found it necessary to rearrange the windings of the armatures, the Council should agree to their doing so, or making any alterations that would contribute to the successful fulfilment of the contract. This suggestion had been accepted by the Committee. In the action—Westlake and Others—for damages for vibration, &c., a claim of £725 was made for personal injuries. In order to save expense in further litigation, an offer of £100 is to be made to the plaintiffs. In the action for an injunction, the plaintiffs' costs have been taxed at a net sum of £1,075. A loan of £12,723 for electricity purposes is to be obtained.

L.C.C. POWER BILL.—The Kent C.C. has unanimously decided to offer opposition to the Bill.

BERMONDSEY.—The report of the district auditor on the accounts of the electricity undertaking has been submitted. In regard to the cost of opposing electric power Bills in Parliament the auditor says that the Council in charging the costs of such opposition directly upon the rates is acting within its statutory powers. In future, however, the Finance Committee recommends that all such expenses shall be charged to the electricity fund, with the exception of opposing the L.C.C. Bill; this is to be allocated in moieties to the electricity and general funds. In regard to the charge for public lighting, the auditor thinks there is no ground for taking exception to the charge of 2¼d. for energy and maintenance for public lighting. It may be remembered that the London Electric Supply Corporation offered to supply energy for public lighting at 1¾d. per unit. The auditor states that the charge of 2¼d. has been practically reduced to a parity with the offer made by the company.

In regard to the cost of opposing the L.C.C. Power Bill, the B.C. has not agreed to the recommendation of its Finance Committeee, but has decided to charge the whole cost to the general fund.

It would appear that the dust destructor, which is working in conjunction with the electricity undertaking, is incurring a charge on the borough of about £3,000 in excess of other methods of disposal of refuse, and even after allowing full value for steam raised, the auditor questions whether the B.C. would not save money by disposing of the refuse by barging. He says in this connection that the opinion expressed by the electrical engineer that he could generate more economically without the destructor has an important bearing on the question.

The auditor states that he does not consider that the charge allocated to the revenue in respect of central establishments, &c., is as yet sufficient. He also criticises the accounts in other particulars, and, needless to say, the Committee does not agree with all his criticisms.

WESTMINSTER.—The City Council last week resolved that no further action be taken in regard to the L.C.C. power Bill until after the election to-morrow.

HACKNEY.—The Joint Finance, E.L. and Law and Parliamentary Committee has reported with reference to winding up the agreement with Mr. Robert Hammond, the consulting electrical engineer, and it has agreed with Mr. Hammond (subject to the confirmation of the B.C.) that a supplementary agreement be entered into with him providing for the termination of the agreement dated March 1st, 1899, except as regards the work he has in hand, which is not yet completed.

MARYLEBONE.—The Electric Supply Committee reported on Tuesday having settled the following details in connection with the tariff charges for the supply of electricity adopted by the Council in July last:—Two winter quarters, 8d. per unit, first 200 hours of maximum demand, and during the two summer quarters 8d. per unit for the first 50 hours' use of the same; 1d. per unit for all further consumption. For special lighting purposes consumers will be charged at the uniform rate of 2d. per unit, such as basements not used for sleeping purposes, and for parts of premises in which the use of artificial light during daylight hours is necessitated by the situation or construction of the said premises, or the supply of advertising signs or contractors' electrical fittings. The application of this rate to any circuit is to be subject to the approval of the Electric Supply Committee. For purposes other than lighting consumers will be charged 2d. per unit for 125 hours' maximum demand per quarter, and 1d. per unit for all energy consumed in excess. The consulting engineer has been in negotiation with Messrs. Parsons, and has provisionally arranged a basis of settlement of the various points, which has been embodied by the solicitors in a memorandum which will be sealed by the contractors and the Council. In March last an agreement was entered into with the Hampstead B.C. for the adjustment of the areas of supply of that borough and Marylebone. On account of the slightly higher Marylebone charges, the Committee has decided to charge the consumers taking supply from the Hampstead area according to the old rates until the half-yearly meter reading in June last, and to remit to consumers who had already paid the increased charges before that date, the difference between those charges and the old rate. The L.C.C. is to be requested to issue stock for the purpose of placing the Borough Council's main electricity loan of £1,400,000 upon a permanent basis.

Mansfield.—The T.C. has decided to retain Messrs. Hammond & Son, at a fee of 50 guineas and expenses, to advise it for a year on any points that may arise in connection with the electricity undertaking.

Newark.—The Council has intimated that it is not prepared at present to undertake any electricity supply to the borough, and has authorised the E.L. Committee to enter into a draft agreement with the Mutual Electric Supply Co.

Newquay.—The Newquay E.L. & P. Co. has tendered for the public lighting of the town. The prices vary from £1 1s. for one 32-C.P. lamp to £2 2s. 6d. for two 50-C.P. lamps, without fittings; from £3 to £3 17s. 6d. for the same lamps with fittings. The former figures apply to a three, five or seven years' contract; the latter to a three years' engagement. If fittings are supplied, the terms for five years will be from £2 5s. to £3 7s. 6d., or for a seven years' contract from £1 18s. to £3 0s. 6d. The Newquay Gas Co. sent in a tender of £2 1s. 10d. for each incandescent light of 45 C.P. For 70-C.P. burners an additional 6s. 6d. would be charged, and for 100-C.P. burners 9s. 6d.

Pontefract.—The Corporation has confirmed a previous resolution to apply for an E.L. prov. order for the borough.

South Africa.—PORT ELIZABETH.—The electrical engineer has reported that the following amounts will be required to complete the E.L. undertaking:—Overspent on loan, £5,000; third turbine set already ordered, £4,000; assisted wiring scheme—150 consumers per annum for two years, £6,000; meters and services—600 consumers at £10 average, £6,000; mains extensions, £4,000; total £25,000. The Committee recommends that a meeting

of the ratepayers be convened to obtain their sanction to a re-allocation of this sum of £25,000 out of a sum of £50,000 previously voted for other purposes.

Southampton.—The T.C. has decided to supply energy for all-night use, to the London and South-Western Railway at 2d. per unit up to 50,000 units per annum, and 1½d. beyond.

Southend-on-Sea.—The T.C. has fixed the price of energy to the tramways at 1½d. per unit.

Stratford-on-Avon.—We have received a copy of a booklet from the Stratford-on-Avon Electricity Co., giving general information for users of electricity, wiring regulations and conditions of supply, &c.

Sunderland.—Messrs. T. S. Forster & Sons, of Pallion, have recently installed a suction gas electric generating plant for power and lighting purposes in their works. On the other hand, Messrs. W. T. Doxford & Sons, shipbuilders, have recently discarded their private power plant and commenced taking a supply of electrical energy from the Corporation. Their contract is said to be for a period of 12 years.

Swinton.—Messrs. Callenders are now laying down mains in the district for the Lancashire Electric Power Co. It is proposed to erect a sub-station for this area.

West Ham.—Tenders are to be obtained for the supply of a cooling tower and tanks with a view to enabling the Finance Committee to make application to the L.G.B. for sanction to a loan for the whole of the additional plant required at the generating station. The electrical engineer has arranged to charge consumers using radiators, arc lamps, and similar apparatus, by the hour, if they desire it. This entails no difference in the charge per unit, which is precisely the same, viz., 3d. and 2d. respectively, and does not refer to the experimental arrangement approved recently of charging per hour inclusive of current, carbons, cost of lamps, &c., which Mr. Seabrook hopes soon to be in a position to recommend as a general system. The Electricity Committee has had under consideration a letter from the Charing Cross, West End and City Electricity Supply Co., stating that the company is prepared to supply the Council with energy in bulk on a contract for seven years at a charge of £4 per annum for each KW. of the maximum demand and ½d. per unit for all energy delivered at any point within the borough at a pressure of 10,000 volts measured at the end of the company's supply main, subject to the energy supplied at the above rate not amounting to less in value than 20 per cent. per annum of any outlay incurred by the company in making provision for the supply, and also offering to supply motor-generators for stepping down to the pressure required in the borough, together with the necessary switchboards, &c., at reasonable terms of hire-purchase. The Committee has stated that it could see no necessity for making arrangements for a supply of energy in bulk, but in any case the charges of the company were so high that it should not recommend the Council to entertain the offer.

Willington.—DURHAM.—The U.D.C. has again had the question of overhead distribution by the Durham Electrical Power Co. under discussion; despite the advantages of cheaper supply and the ordinary character of the work proposed, the Council decided to continue its obstructive tactics.

Woolwich.—The L.C.C. desires to exclude Woolwich from its power supply scheme, but the latter Council does not agree to this. No doubt even the L.C.C. can grasp the state of affairs existing at Woolwich. The B.C. has passed a resolution to the effect that the L.C.C. Power Bill will operate to the prejudice of the ratepayers of the borough unless amended so as to render it obligatory on the L.C.C. to acquire the Council's undertaking.

Yardley.—The Birmingham city electrical engineer has asked the Council if it is prepared to consent to the laying of mains for the supply of electrical energy within the district.

TRAMWAY and RAILWAY NOTES.

Belfast.—The directors of the Whitewell and Cave Hill Tramway (who are promoting a Bill which seeks for running powers over the Corporation lines) have intimated their willingness to meet in conference the Tramways and Electricity Committee with regard to the Bill. The Committee has decided to hold a conference at an early date.

Birmingham.—After many conferences with representatives of the King's Norton and Northfield U.D.C., an arrangement has been come to for the working by the Corporation as from January 1st last to December 31st, 1927, of the Moseley and King's Heath tramways, and from July 1st, 1911 (when the old company's lease expires), until December 31st, 1927, of the Pershore Road and Bristol Road tramways, and also of any new tramways within the King's Norton U.D., which may be physically connected with the tramways of the Corporation. The latter body will receive from the Council 4d. for every car-mile run, the Council to provide the energy and maintain the track. The Corporation, however, is to pay over to the Council all receipts in respect of fares taken within the latter's district.

Cardiff.—The city treasurer has pointed out how inadequate is the amount now standing to the credit of the depreciation and renewals fund of the tramways undertaking. The statement seems to have created a good deal of discussion in the city. The reserve fund in hand amounts to £9,721, and the treasurer estimates the deficiency at £63,367. He recommends that £5,500 be set aside annually for depreciation.

Clacton-on-Sea.—The Light Railway Commissioners on the 25th ult. held an inquiry into the application of the Clacton-on-Sea and Osyth Light Railway Co. for the extension of the tramways, for an extension of time for carrying out the order, and for the capital to be increased from £39,000 to £66,000. The U.D.C. opposed the extension of the system, and the Commissioners refused this part of the application, but extended the time to seven years.

Continental Notes.—GERMANY.—The Highways Committee of the Berlin C.C. decided some time ago upon the construction of an underground electric railway between the northern and southern parts of the capital. In arriving at this decision, it was apparent that the conviction prevails that there are already sufficient surface tramways in the streets (over 300 miles reckoned as single track) without causing further congestion of the traffic and that a more rapid means of communication would be afforded by the establishment of an underground shallow line similar to the underground section of the Berlin elevated electric railways.

The receipts of the Berlin tramways for 1906 were 35,174,338 M., against 34,289,165 M. in the previous year; the expenses came to 18,968,847 M., against 18,748,116 M., making a profit of 639,022 M. to the city, against 377,789 M. The net profit to the shareholders came to 9,902,124 M., against 9,292,204 M., enabling the distribution of a dividend of 8 per cent. instead of 7¾ per cent., as in 1905.

SPAIN.—The Hidro-electrica Iberia Co. and the Sociedad Tranvias Electricidad de Bilbao are combining with the purpose of erecting and working conjointly a large central generating station at Olaviaga, in the vicinity of Bilbao. Three generating sets of 2,000 H.P. each are to be installed, consisting each of a steam turbine driving a three-phase alternator and a continuous-current dynamo.

Dumbarton.—On Tuesday last week the B. of T. inspection of the tramways in this district took place. The promoters of the scheme were the Electric Supply Corporation. The formal opening ceremony was carried out on the following day, when a number of officials and local men, together with the Provost, travelled over the various routes. The Provost afterwards declared the system open. A luncheon was provided by the company in the Lesser Burgh Hall, when Mr. K. A. Scott-Moncrieff, the chief engineer and general manager, occupied the chair. In the course of a speech Mr. Scott-Moncrieff stated that the Dumbarton tramways, he hoped, were the commencement of a much larger scheme. The company had obtained an order for a county system, and he hoped that in the course of a short time tramway communication between the town and the neighbouring municipalities of Glasgow and Clydebank would be available. The total length of the present system is about 3 miles of single track with passing places. The contractors for the permanent way were Messrs. Dick, Kerr & Co., and the six double-deck, top-covered cars were supplied by the Brush Electrical Engineering Co., the equipment being of the British Westinghouse Co.'s make and the trucks by Messrs. Mountain & Gibson.

Epping.—The proposal to extend the Walthamstow and Leyton tramways along the Epping New Road seems to be resented by those desirous of retaining the beauty of the Forest intact.

Glasgow.—In view of a proposal to combine the lighting and power stations of the T.C., the general manager of the tramways has been asked to draw up a report.

Isle of Wight.—It is reported that a committee of the County Council has recommended for approval a proposal to electrify the railways of the island.

Leicester.—A report on the working of the Leicester Corporation tramways, presented to the T.C., shows that the total revenue for the year 1906 amounted to £116,528, an increase of £6,987 on the previous year. The passengers carried numbered 27,467,984, an increase of 1,577,954. The car-miles run were 3,331,998, or a decrease of 10,250 on 1905. The total receipts averaged 8·39d. per car-mile The working expenses amounted to £68,940, or an increase of £5,112.

Liverpool.—Much inconvenience was caused to passengers on Tuesday evening last week on the Lancashire and Yorkshire Liverpool-Southport section. The conductor rail was shorted by telephone wires, which collapsed during the gale. Traffic was interrupted for about three hours.

London.—L.C.C.—At a meeting of the Council on Tuesday the Highways Committee reported that it had arranged with the Woolwich B.C. for the supply of power for working the tramways between Beresford Square, Woolwich, and Plumstead at the rate of 1d. per unit for a period of one year, and after that period at cost price, but not exceeding 1d. per unit. The Committee presented a report referring to the necessity for the provision of a central car repair depôt of a permanent character. When the cars were comparatively new the repairs which were necessary were not of an extensive character, and they could be done at the particular depôts from which the cars were operated. This arrangement, however, was no longer practicable in view of the increase in the

rolling stock, and owing to the more extensive repairs which have to be executed. The cost of erecting buildings would be £99,000, but a first section could be built for £54,000, and the tools and equipment would involve a further expenditure of £16,000. The Committee asked for authority to prepare a scheme to give effect to the proposal.

After lengthy negotiations between the L.C.C. and the Chancellor of the Duchy of Lancaster in regard to the extension of the Kingsway Subway to the Embankment, it has been arranged in view of the construction of tramways, that the sum of £9,400 be allowed by the Highways Committee, subject to approval by the Council, to cover all damage other than structural to the property of the Duchy.

Last week four people were injured, two seriously, through a tramcar colliding with a carriage in York Road, Battersea.

Portsmouth.—The Light Railway Commissioners recently held an inquiry respecting the application of the Hampshire Light Railway Co. for powers to extend the Portsdown and Horndean tramway at a cost of £4,124. The only objection was in regard to the power station at Purbrook, which was regarded as a nuisance by those opposing, who asked for its removal. The commissioners granted the order without imposing any conditions.

South Africa.—JOHANNESBURG.—The results of the six months' working of the tramways to December 31st last are as follows:—Total revenue, £113,339; total working expenses, £63,127; total financial charges, £28,785; net surplus, £21,427.

South Lancashire.—The B. of T. has this week inspected the South Lancashire Tramway Co.'s line from Unity Brook, Kearsley, to Newtown, Pendlebury. It is expected that this new section and the one from Worsley to Alder Forest, Winton, will be in full operation in a day or two.

Torquay.—The B. of T. inspection of the Torquay tramways is expected to take place next Wednesday, 6th inst. The first routes to be opened, we understand, will be from Beacon Quay to Torre Railway Station and the Ellacombe route. A statement to the effect that an excessive amount of energy is used in operating the tramways is officially denied.

Whickham (Durham).—At a special meeting of the U.D.C. on the 25th ult., Mr. R. Rutherford, chairman, said the Gateshead and District Tramways Co. had offered to contribute £400 if the Council would free the company from the obligation to extend its tramways from Cross Keys to the Dun Cow. Mr. Morrison, the manager of the Tramways Co., said the suggested extension would be of no use. If the Council intended making the new road between Dunston and Swalwell, he would be the first to push forward a scheme for taking the tramways along that road. Eventually the Council agreed to accept the proffered £400.

TELEGRAPH and TELEPHONE NOTES.

Canada.—TORONTO.—The Bell Telephone Co., who work the telephone system of the city, are in a dispute with their female employés, and recently some 400 came out on strike for a few days. The girls at present work five hours daily at wages ranging from $18 to $25 per month. The company propose to increase the hours from five to eight hours daily and to increase the maximum salary by $5 per month. The girls wish the present hours and the present rate of pay to be continued. In order to get at the facts, the Dominion Government has ordered an inquiry, and a commission is now sitting in Toronto. The employés have, in the meantime, returned to work, so that the public telephone service may not be disorganised.

Chile.—There are in Chile 12,579 kilometres of telegraph line, 287 telegraph stations, and 896 officers. There are also a number of private Chilian and British telegraph companies, including the Cable West Coast Co. Trials have been made on Chilian war vessels with wireless telegraphy, and the Marconi Wireless Telegraph Co. has secured patent rights in Chile for a period of five years. There are in Chile one British and several Chilian telephone companies.

Costa Rica.—A recent report states that the telegraph line system of that country is 1,523 kilometres long with 74 stations; the number of messages dispatched in 1905 amounted to 418,000. The establishment of a cable station in Costa Rica is talked of. There is no cable on the Atlantic coast, but the United Fruit Co. has a wireless system communicating with Bluefields (Nicaragua) and Bocas del Toro (Panama).

Mercadier Telegraph System.—The Mercadier system is the invention of an engineer of the French Post Office, and is an application of the law that undulatory currents passing over a wire will not disturb each other if they are not of exactly the same frequency. Five years ago the system had a lengthy trial in England and France, but was rejected because the undulatory currents set up heavy induced currents in neighbouring wires, and thus disturbed other apparatus. M. Mercadier has now overcome this difficulty, and the French Administration has been so far impressed that it has set about trials of the whole system on wires running from Paris and Havre. News now comes from M. Magunna, a collaborator and assistant of Mercadier, that these line trials are a complete success. M. Magunna also makes the announcement that on an artificial line 600 kilometres in length, he has been able to operate the ordinary Morse sounders, the Hughes and the Baudot systems of telegraphy by means of syntonised undulatory currents. The experiments were carried out at the Central Office at Paris last week, and have demonstrated the possibility of attaching as many as 12 sets of apparatus of the ordinary pattern to a single wire, and operating them simultaneously. Undulatory currents "tuned" by means of electrically vibrated tuning forks are used, and the pitch differs in the case of each set of apparatus. Perfect Morse marks or printed letters with the Hughes and Baudot are thus transmitted. The system opens up limitless opportunities of increasing the carrying capacity of a single wire, and will attract the attention of telegraph authorities and newspapers with private wires who are interested in getting as much work as possible over a single wire.

Scottish Telegraphs.—Last week a large deputation from public bodies in Scotland waited upon the Postmaster-General and urged upon him the necessity of extending the underground telegraph system northwards from Glasgow to Aberdeen. The Postmaster-General replied that the extension to Edinburgh would if possible be completed this year, but he held out no immediate prospect of further extension.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	..
Paramaribo-Cayenne	Nov. 27, 1906	..
Cayenne-Pinheiro	Aug. 18, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Dominica-Martinique	May 7, 1902	..
Curacao-Coro / Curacao-La Guayra / Curacao-Maracaibo — Closed	Jan. 12, 1906	..
Keissa-Issa and Keissa-Yemani (Yemen)	Oct. 22, 1902	..
Tarifa-Tangier	Jan. 18, 1904	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904	..
Garachico-Santa Cruz	July 12, 1906	..
Las Palmas-Arecife	Aug. 18, 1906	..
Guantanamo-Mole St. Nicholas	Nov. 22, 1906	..
Fao-Bushire	Dec. 4, 1906	..
Martinique-Paramaribo	Dec. 17, 1906	..
New Brunswick-Prince Edward Island	Jan. 9, 1907	..
Odessa-Kilios	Feb. 9, 1907	..
Tenedos-Chio	Feb. 13, 1907	..
Tenedos-Lemnos	Feb. 24, 1907	..
Rhodes-Sitia	Feb. 25, 1907	..
Landlines.		
Puerto-Barrios	Aug. 28, 1902	..
Alep-Bagdad	Feb. 18, 1907	Feb. 20
Diarbekir-Bagdad	Feb. 18, 1907	Feb. 20
Bagdad-Hanekin	Feb. 20, 1907	Feb. 21

Successful German Cable Competition. — The North-German Marine Cable Works Co., of Nordenham, is reported to have received an order for the manufacture and laying of a submarine cable between St. Petersburg and Copenhagen *viâ* Libau. It appears that the order, which has been placed with the company by the Great Northern Telegraph Co., of Copenhagen, has been received in severe competition with cable makers of other countries. The Great Northern Co. recently obtained the permission of the Russian Government to establish the connection on Russian territory, and the work has to be completed next September. It is stated that the order given to the German cable firm, and some small orders procured from foreign governments, will keep its works fully employed until the autumn of the present year.

CONTRACTORS' COLUMN.

Openings for New Business.

ACTON.	Two villa residences, Birch Grove, electric light intended. W. Daley & Co., builders, 8, Twyford Avenue, Acton Hill.
Do.	Council offices (£35,000). W. G. Hunt, architect, 17, Vicarage Gate, Kensington W.
ANNFIELD PLAIN.	Fire station and store shed, &c., to be built at Dipton for the District Council.
BANGOR (Park Hill).	Calvinistic Methodist Chapel. Richard Davies & Son, architects, Bangor.
BIRMINGHAM.	Concert hall, Walter de Freece, owner.
BOLTON (Daubhill).	Primary School. Fredk. Wilkinson, Director of Education, Nelson Square, Bolton.
BRADFORD.	St. Cuthbert's Roman Catholic school. J. Simpson, architect, Cunliffe Terrace, Bradford.
BRIGHTON.	New maternity hospital in connection with the Brighton's Women's Hospital.
BRISTOL.	High-class villas on Druid Stoke Building Estate. Mr. Milverton Drake, Baldwin Street, Bristol, architect.
Do.	Several large two-storey transit sheds at Royal Edward Dock, Avonmouth. (In recent Corporation dock sheds electric cranes and lighting have been introduced.) W. W. Squire, dock engineer, Cumberland Road, Bristol, engineer.
BROMLEY.	Fire station and mortuary. Stanley Hawkins, borough engineer.
BURNLEY.	Public baths (Burnley Lane district). Mr. Pickles, borough surveyor.
Do.	Sion Baptist Chapel, Yorkshire Street (electricity agreed upon). Rev. J. D. Robertson, Colne Road, Burnley.
Do.	Enlargement of Victoria Hospital decided upon by the Governors.

CARMARTHEN.	Alterations to borough police station. Borough Surveyor, John Street.
COVENTRY.	New laundries and mortuary for Coventry and Warwickshire Hospital. Architect, Mr. H. W. Chattaway, Trinity Churchyard, Coventry.
CRICKLEWOOD.	Baptist Chapel and Sunday School in Anson Road. Arthur Keen.
DALKEITH (N.B.).	Extensions to Municipal Buildings, £1,650. Charles H. Greig, architect, Municipal Offices, Dalkeith.
DENBEATH (Fife).	Wemyss Coal Co. Boiler and engine houses for huge pit being sunk at Denbeath.
DERRY.	Reconstruction of Long Tower Church. Father Wm. Doherty.
DUMFRIES (N.B.).	St. Joseph's Commercial College, new buildings, £10,000. The Madist Brethren, Mount St. Michael. Dumfries, are the proprietors.
DUNDEE.	Proposal to erect workmen's dwellings. Plans being prepared by Mr. Thomson, city architect.
DUNFERMLINE.	School of Weaving. (Carnegie Trust, Dunfermline pay £1,880 toward site.)
EBBW VALE.	Workmen's hall for Ebbw Vale Colliery Workmen's Trustees. H. Waters, architect, Beaufort.
EDINBURGH.	Additions to Castle Breweries, owners, G. and J. Maclachlan. Hamilton Paterson & Paterson, architects, Edinburgh.
EPSOM.	Baptist Church. T. F. Waddell, South Street, Dorking, architect.
EXETER.	Annexe to Royal Albert Memorial College; electric lighting installation; a municipal building. Jas. Jerman, architect, Bedford Circus, Exeter.
Do.	Devon and Exeter Hospital. Full electrical equipment for medical purposes decided on February 21st. E. H. Harbottle, hon. architect, D. and E. Hospital, Queen Street, Exeter.
FALKIRK.	New premises for Grahamston and Bainsford Co-operative Society, to cost £6,000. T. C. Wade, solicitor, Falkirk.
GAINSBOROUGH.	New Town Hall and Markets Extension for the Urban Council. Brameld & Meek, architects, Manchester.
GLASGOW.	Merchants' house. Frank Burrett.
Do.	New drapery warehouse. Secretary, Scottish Co-operative Wholesale Society, Glasgow.
Do.	Chocolate factory. Carsons, Limited, Barrowfield, Glasgow.
Do.	Naphtha refinery. Kelvindale Chemical Co., 67, West Nile Street, Glasgow.
HALIFAX.	(1) New school at Ovenden. C. F. L. Horsfall & Son, architects. (2) Mission room, Illingworth. A. G. Dalzell, architect. (3) New Baptist chapel, Lee Mount. Abraham Sharpe, architect. (4) Golf club house, Race Course. Jackson & Fox, architects. (5) Mission room at Pye Nest. Jackson & Fox, architects. (6) Chapel, school, &c., Boothtown. C. T. L. Horsfall and Son, architects. (7) New school at All Saints' Church, Salterhebble. Walsh & Nicholas, architects. No. 1 wants electric light; Nos. 2 and 6 are negotiating for it; Nos. 5 and 7 have asked for electric light, but the existing mains are too far away, and the municipality will not extend mains at present.
HAM (Thames Valley).	Council offices. (Plans under consideration.)
HANLEY.	Council chamber (£2,500). For the Town Council.
HARLESDEN.	20 houses in Normanby Road. J. C. Hill, 14, Archway Road, Highgate, builder.
ILFORD.	50 houses in Milverton Gardens. H. A. Rawlins, Ilford.
Do.	Church, Ilford Lane. F. Smith & Co., contractors, Ilford.
Do.	School. C. G. Dawson, 11, Cranbrook Road, Ilford, architect.
LANCASTER.	Wesleyan Church, Skerton, £3,000. Mr. S. Wright, Mayor of Morecambe (with Messrs. Austin and Paleys, of Lancaster). Contracts not let yet.
Do.	Wesleyan Mission Church, £3,000. The Greaves. Contracts not let yet.
LEIGH (Lancashire).	Council School, Windermere Road. J. C. Prestwich, Bradshawgate Chambers, Leigh, architect.
LIVERPOOL (Aigburth Vale).	Secondary school. Jones & Sons, builders, 25, Pleasant, Street, Liverpool.
LONDON (Marylebone, W.).	Rebuilding Church Army Headquarters. Hudson and Hunt, 24, York Place, Portman Square, W. architects.
Do. (Deptford).	Mortuary and Coroner's Court for Borough Council.
Do. (Wood Green).	Baptist church. Rev. W. Winston Haines, chairman, Building Committee.
Do. (New Cross, S.E.).	Additions to Goldsmith's College. Reginald Blomfield, 1 New Court, Temple, E.C., architect.
Do. (Southwark).	Library at junction of Old and New Kent Roads. F. and H. F. Higgs, Loughborough Junction, S.W., builders.
Do. (Oxford Street).	Buildings (upon site of Nos. 158, 160, 162). J. Belcher, A.R.A., architect, 20, Hanover Square, W.
Do. (Dulwich).	Parochial Hall, Townley Road, for the Estates Governors of Alleyn's College of God's Gift.
Do. (Hackney).	Mission Hall. J. Hamilton, architect, 23, Wormwood Street, E.C.
Do. (Plaistow, E.).	Extension St. Mary's Hospital for Sick Children. A. Saxon Snell, 22, Southampton Buildings, W.C. architect.
Do. (Chelsea).	Buildings upon site of Nos. 247-257, King's Road. W. E. Clifton, East India Avenue, E.C., architect.
METHIL (Fife).	Police office extension. Mr. Henry, architect, St. Andrew.
MERTHYR TYDFIL (Twynyrodyn).	50 houses. Borough surveyor.
MORLEY.	Extension of mills. T. A. Buttery and S. D. Birds, architects, Queen Street, Morley.
PAISLEY.	Suite of buildings. Wesleyan Methodists' secretary, Paisley.
PAISLEY.	Thirty-one houses. Marchfield Estate Co., Mckinnon Road.
Do.	Buildings. Brown & Polson, Ltd.
REDCAR.	Council schools. J. M. Bottomley & Son & Wellburn, architects, 28 and 30, Albert Road, Middlesbrough.
REIGATE.	Children's ward (£1,000) at Reigate and Redhill Cottage Hospital.
SALFORD.	Workshops and offices at the mains depôt of the Electricity Committee, in Frederick Road, Broughton. Borough electrical engineer.
Do.	Extension of hospital accommodation, and erection of nurses' home. Architect. J. Healey, King Street West, Manchester.
SHEFFIELD.	Annexe at Fulwood for the Royal Hospital. Gibbs and Flockton, architects, 15, St. James Row, Sheffield.
Do.	Medical superintendent's residence, Isolation Pavilion and Observation Pavilion (Infectious Hospital). Gibbs & Flockton, architects, 15, St. James' Row. Sheffield.
Do.	Post office. Commissioners of H.M. Works, Storey's Gate, London, S.W.
SOUTHPORT.	All Souls' new church. Vicar, the Rev. Dr. Porter.
ST. ALBANS.	Extension of grammar school (£8,274). Ekins & Co., builders, Hertford.
STOCKTON-ON-TEES.	31 houses (Castlereagh Road). T. E. Atterbury, builder, Stockton.
STONEBRIDGE, N.W.	Mission Hall in Melville Road. H. Shaw.
SWANSEA.	Extension to high school (£4,000). Town Council.
WAKEFIELD (Hemsworth Collieries).	180 houses, stores, club and institute. Garside and Pennington, architects, Pontefract.
WELLINGBOROUGH.	Post Office (£3,615). Brown & Sons, Ltd., builders, Castle Street, Wellingborough.
WEST BROMWICH.	Pupil teachers' centre and extension of secondary schools (£5,000). G. Webb, Handsworth, Birmingham, builder.
WIGAN (Pemberton).	Weaving shed for 400 looms. Pemberton Manufacturing Co.
WIGTON.	New creamery. Secretary, Scottish Co-operative Wholesale Society, Glasgow.
WILLESDEN.	Central Fire Station for District Council, plans under consideration.
WIMBLEDON.	School. A. Steele Sheldon, 12, Queen's Road, Wimbledon, clerk to Education Committee.
WORCESTER.	Extensions to Victoria Institute (£4,825). J. & A. Brazier, Worcester Road, Bromsgrove, builders.
WORTHING (Sussex).	Library, art gallery and museum (£10,216). Wisdom Bros., builders, South Street, Isleworth.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdeen.—March 19th. Surface condenser, with air pump, oil separator, &c., for the Corporation Electricity Department. See "Official Notices" February 22nd.

Algeria.—March 11th. The Inspection Générale des Postes et des Télégraphes in Algiers is inviting tenders for the supply of 4,800 metres of paper-insulated telephone cable (112 pairs of conductors), and 9,000 metres of special paper-insulated cable (one pair of conductors).

Austria.—Bosnia-Herzegovina.—July 27th. The Government construction department at Serajevo invites tenders by July 27th for five to eight motor-cars for the electric tramways of that town.

Battersea.—March 5th. Various materials for the electricity department. See "Official Notices" February 15th.

Belgium.—March 5th. Installation of electric bells and telephones at the Auderlerhb-lez-Bruxelles Town Hall and other buildings. Post 5d. Letters must be registered. A public adjudication will take place on March 8.

Belgium.—March 30th. The municipal authorities of Liége invite tenders for a central station. For further particulars see our issue of January 25th.

Bolton.—2,000-H.P. engine, stokers, balancer and coal conveyor for the Corporation electricity works.

Bray.—March 19th. Supplies for the U.D.C. electric light works. See "Official Notices" to-day.

Bristol.—March 8th. Unwashed small coal for the Electricity Department. Specifications from the City Electrical Engineer (two guineas).

Cheltenham.—March 22nd. One 1,000-KW. turbo-generator, condensing plant, steam and other piping, &c., for the Corporation electricity supply extensions. See "Official Notices" to-day.

Christiania.—March 11th. Tenders are invited by the Norwegian State Telegraphs for the supply of cable, insulators, Morse paper, tarred wire, bronze wire, copper wire, &c. branching-off cable. Tenders to No. 3 Room, Hasselgaardem, Christiania. Copies of the conditions of tender, specification and original advertisement (all in Norwegian) may be seen at the Commercial Intelligence Branch of the B. of T., 73, Basinghall Street, London, E.C.

Copenhagen.—March 18th. Two steam turbine alternators (three-phase), 2,500 KW. each, for the Corporation. See "Official Notices" January 25th.

Copenhagen.—April 11th. Three motor-generators or converters, each 1,000 KW., for the Corporation. See "Official Notices" to-day.

Eccles.—March 9th. Lancashire boiler, superheater, economiser, 100-KW. engines, and D.C. dynamos for the Corporation. See "Official Notices" February 22nd.

Eccles.—March 16th. Storage battery and automatic reversible booster for the Corporation. See "Official Notices" to-day.

Glasgow.—March 25th. Steam turbo-alternators with condensing plant for the Pinkston generating station. See "Official Notices" February 22nd.

Gravesend.—March 2nd. Coal, engine room stores, carbons, meters and indicators, &c., for the Corporation. See "Official Notices" February 15th.

Handsworth.—March 7th. Switchboard extension and equaliser booster for the U.D.C. See "Official Notices" February 15th.

Hoylake.—March 7th. Tenders for 63-cell battery for the U.D.C. See "Official Notices" February 22nd.

Iceland.—March 31st. The Reykjavik Town Council is open to give a concession for the supply of electrical energy and gas. See "Official Notices" December 7th.

L.C.C.—March 19th. Ten induction motor-generators of 500 KW., and four of 150 KW. See "Official Notices" to-day.

Maidstone.—March 18th. Construction and equipment of light railways (permanent way, overhead work, mains, switchboard, rolling stock and buildings) for the Corporation. See "Official Notices" to-day.

Marylebone.—March 13th. Stores for the electricity department. See "Official Notices" February 15th.

Marylebone.—March 13th. House meters for one year, for the Electricity Department. See "Official Notices" Feb. 22nd.

Perth (Western Australia).—March 25th. Lead-covered paper-insulated telephone cable. See our issue of February 1st.

Portsmouth.—March 11th. Stores, &c., for the Corporation tramways. See "Official Notices" to-day.

Sheffield.—March 4th. Water storage reservoir, valves, screens, &c., for the City Council. See "Official Notices" February 15th.

Sheffield.—March 25th. Machines for regulating the power factor of an A.C. supply system for the electric supply department. See "Official Notices" February 15th.

South Australia.—March 6th. The Postmaster-General requires tenders for telephone and telegraph material. For particulars see our issue of January 18th.

Spain.—March 9th. The Post and Telegraph Department at Madrid require tenders for telegraph wire as follows:—60 tons galvanised-iron wire of 4 mm. diameter, 15 tons wire of 3 mm., and 5 tons wire of 2 mm. Tenders to Direccion General de Correos y Telegraphos, Carretas 10, Madrid.

Spain.—March 14th. The Director-General for Posts and Telegraphs requires tenders for 60,000 porcelain insulators (Spanish telegraph type No. 2) by March 14th, 11 a.m. A deposit of 5 per cent. is required. Tenders to Direccion General de Correos y Telegraphos, Carretas 10, Madrid.

Spain.—March 14th. The Drainage Commission of Santa Maria de Belsué, at Huesca, requires tenders for plant and material for the construction of a water-power driven electrical installation, and for the transmission of power over its drainage area. Particulars may be obtained from, and tenders addressed to, the Junta, &c., at the above place, by March 14th.

Spain.—March 18th. Ten thousand sulphate of copper injected (Boucherie system) telegraph poles, 6½ to 7 m. high. A deposit of 5 per cent. of the tender is required.

Spain.—March 31st. The Harbour Works authorities at Huelva are inviting tenders for the establishment of a central station for the supply of the necessary electrical energy required for lighting and power purposes at the harbour.

Spain.—Tenders are at present being invited for the concession for the construction and working of an electric tramway between Balza and Santuario de la Yedra (province of Jaen).

Spain.—The municipal authorities of Turis (province of of Valencia) have just invited tenders for the concession for the electric lighting of the town during a period of 10 years.

Sunderland.—March 1st. (*a*) Buildings and shaft; (*b*) three-phase turbo-generator, condensing plant, cooling towers; (*c*) water-tube boilers, economisers, &c., for the Corporation. See "Official Notices" February 8th.

Sunderland.—March 7th. Tramway wheel lathe for the Corporation. See "Official Notices" February 22nd.

Swindon.—March 11th. Materials for the electricity and tramway department for one year. See "Official Notices" February 22nd.

Sydney (N.S.W.).—March 6th. Tenders for the supply of 7½ tons of hard-drawn copper wire, 200 lb. per mile. For further details see our issue of January 25th.

Watford.—March 7th. Supplies for the U.D.C. Electricity Department. See "Official Notices" to-day.

West Ham.—March 18th. Mechanical stokers and cooling tower for the Corporation electricity department. See "Official Notices" to-day.

Wrexham.—March 15th. Supplies for the T.C. electricity department. See "Official Notices" to-day.

CLOSED.

Cheltenham.—The Education Committee has accepted the tender of Messrs. H. E. Steel, Ltd., of Cheltenham, for installing the electric light at the Naunton Park and Gloucester Road Schools, at £385.

Eccles.—The Borough Education Committee has accepted the tender of Mr. E. Beal for the installation of the electric light at the Lewis Street Schools, at £164.

Glasgow.—The Tramways Committee of the T.C. has accepted the following offers:—

Ambroin arc shields for controllers.—Estler Bros.
Isostabil insulators for trolley bases.—Estler Bros.
Crucibles for brass foundry.—George Smith.
Cable hose.—Clyde Rubber Works Co., Ltd.
Lampholders and bell pushes.—Ross & Co.
Mica.—Micanite & Insulators Co., Ltd.; F. Wiggins & Sons; R. & S. Baxter.
Press-spahn paper.—Micanite & Insulators Co., Ltd.; Estler Bros.
Dry cells.—Siemens Bros.' Dynamo Works, Ltd.
Bond plugs.—P. & R. Fleming & Co.
Alterations to Pinkston buildings.—Good & Mackinnon.
Tinned copper strip.—P. & W. MacLellan, Ltd.

Grimsby.—The T.C. has accepted the tender of the Blasbery Engineering Co. for repairs to the cooling tower at the electricity works, at £205.

Llandudno.—The U.D.C. has accepted the tender of Messrs. Isaac Storey & Sons, Ltd., Manchester, for the supply of condensing plant at the electricity works, at £777.

London.—ISLINGTON.—The B.C. has accepted the following tenders for annual supplies for the electrical department:—

Messrs. J. Knowles & Co.	Wilcox & Co.
Doulton & Co.	Pryke & Palmer.
F. Bird & Co.	Heap & Johnson.
Sloan Electrical Co.	A. Round.
General Electric Co.	Union Cable Co.
British Insulated & Helsby Cables.	India-rubber Co.
Alexander Duckham & Co.	Messrs. Criag & Sharp.

HACKNEY.—The B.C. is to permit Dick, Kerr & Co., who have the contract for the new generating plant, to enter into a sub-contract with Babcock & Wilcox for pipe-work.

STEPNEY.—The B.C. has received the following tenders for the supply of cable, conduits, &c., for the period to end December 31st, 1909:—

CABLE.

W. T. Henley's Telegraph Works Co. (recommended)	£11,945
Western Electric Co.	12,111
W. T. Glover & Co.	12,173
Callender's Cable & Construction Co.	12,231
St. Helens Cable & Rubber Co.	12,281
British Insulated & Helsby Cables, Ltd.	12,330
Siemens Bros. & Co.	12,886

CONDUITS, &c.

	Conduits.	Troughs and covers.
W. T. Henley's Telegraph Works Co. (recommended)	£1,745	£1,236
Siemens Bros. & Co	1,738	1,291
John Knowles & Co.	1,743	1,606
Albion Clay Co.	1,767	1,342
Doulton & Co.	Informal	

L.C.C.—The Education Committee of the L.C.C. has received the following tenders for the installation of the electric light at the Hammersmith Technical Institute, together with motors, bells and fittings:—

Smeeton & Page .. .. (recommended)	£1,368
W. Barton & Sons	1,420
A. W. Penrose & Co.	1,460
Sweet Bros.	1,465
S. G. Cozens	1,484
W. J. Fryer & Co.	1,550
F. A. Glover & Co.	1,626
Higgins & Griffiths	1,650
Wippell Bros. & Row	1,700
Seth Bros.	1,705
J. O. Grant & Taylor	1,914
Army & Navy Auxiliary Co-operative Supply ..	2,184
R. Brightwell	2,185
J. E. Spagnoletti & Co.	2,195
Blackburn, Starling & Co.	2,689

The following tenders have been received by the Highways Committee for (1) the roadwork and platelaying in connection with the reconstruction of the tramways in Goswell Road, Pentonville Road and Gray's Inn Road, and the construction of new lines in St. John Street; (2) the roadwork and platelaying from Vauxhall to Brixton, and new lines from Goose Green to Peckham, and along Tooting High Street and Mitcham Road; and for (3) the supply of 300 trucks for electric cars:—

1.—Tramways in Goswell Road, &c.

R. W. Blackwell & Co. (recommended)	£60,059
Dick, Kerr & Co.	60,945
W. Manders	63,999
J. G. White & Co.	65,675
W. Griffiths & Co.	69,832
J. Mowlem & Co.	70,893
Fry Bros.	73,028

2.—Tramways from Vauxhall to Brixton, &c.

	Tramway works.	Paving works for street widenings.	Total.
W. Manders (recommended)	£77,918	£4,804	£82,722
Dick, Kerr & Co.	78,321	4,732	83,053
R. W. Blackwell & Co. ..	79,525	4,482	84,007
J. Mowlem & Co.	83,011	4,703	87,714
W. Griffiths & Co.	86,960	5,132	92,092
J. G. White & Co.	94,899	6,079	100,977

3.—Trucks for 300 Cars.

Kerr, Stuart & Co.	£40,800
Heenan & Froude	43,500
Mountain & Gibson	44,250
" " .. .. (alternative)	45,030
" " .. .. "	45,510
" " .. .. "	45,600
" " .. .. "	49,350
Peckham Engineering Co.	49,500
Thornewill & Warham	50,700
Metropolitan Amalgamated Railway Carriage Co.	51,675

Since the tenders were sent in Messrs. Kerr, Stuart & Co. had asked to be allowed to reduce the amount of their tender by £5 a set of trucks, making the total tender £39,300, the higher sum having been inserted owing to a clerical error. A similar error was made by Mountain & Gibson, who stated that the amount in each of their alternative tenders should be reduced by £10 a set of trucks, or £3,000 in all. After consideration the Highways Committee has recommended the acceptance of the tender of Kerr, Stuart & Co., for £39,300.

The Hadfield Steel Foundry Co. is to supply, for £16,000, special trackwork for the tramways from Aldgate to Stamford Hill.

West Ham.—The Corporation has accepted the following tenders for the supply of coal to the generating station:—

Cory & Son, Ltd.—7,000 tons of Longhurst, 12s. per ton.
Gunn & Co.—7,000 tons Newdigate, 10s. 9d. per ton.
Phillips & Co., Ltd.—2,500 tons Butterley, 11s. 6d. per ton.

FORTHCOMING EVENTS.

To-Day's Events (Friday, March 1st).—At 3.30 p.m. Institution of Electrical Engineers (London Students). Visit to the Board of Trade Laboratory, Whitehall.

At 7.30 p.m. N.E. Coast Institution of Engineers and Shipbuilders. Mr. W. C. Mountain on "The Application of Electricity to the Driving of Pumping Machinery for Pontoons and Graving Docks."

At 8 p.m. Institution of Mechanical Engineers. Discussion (continued) on the Report of the Alloys Research Committee.

Saturday, March 2nd.—At 3 p.m. Royal Institution. Prof. J. J. Thomson on "Röntgen, Cathode and Positive Rays." (Lecture III.)

Institution of Electrical Engineers (Manchester Students). Visit to the Salford Corporation generating station, Pendleton.

Monday, March 4th.—At 7 p.m. Armstrong College Engineering Society. Mr. B. J. M. Lane on "Development in Electric Machinery."

At 7.30 p.m. Society of Engineers Meeting.

Tuesday, March 5th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester). Mr. Ll. Foster on "Breakdowns in Electrical Machinery."

At 8 p.m. Institution of Civil Engineers. Discussion on paper by Mr. D. Clerk "On the Limits of Thermal Efficiency in Internal Combustion Motors." Mr. A. P. Trotter on "The Construction of Overhead Electric Transmission Lines."

Thursday, March 7th.—At 8 p.m. Institution of Electrical Engineers (London). Mr. J. S. Highfield on "The Transmission of Electrical Energy by Direct Current on the Series System."

At 8 p.m. Civil and Mechanical Engineers' Society. Mr. C. R. Allensby on "Types of Enclosed Steam Water Heaters."

At 8.30 p.m. Chemical Society Meeting.

At 7.30 p.m. Institution of Electrical Engineers (Manchester Students). Meeting.

Friday, March 8th.—At 8 p.m. Physical Society. Prof. Trouton and Mr. Russ on "The Rate of Recovery of Residual Charge in Electric Condensers."

At 8 p.m. Institution of Civil Engineers (Students). Mr. A. T. Arnall on "Corrugations on Tram Rails."

Saturday, March 9th.—At 3 p.m. Royal Institution. Prof. J. J. Thomson on "Röntgen, Cathode and Positive Rays" (Lecture IV).

At 6.30 for 7 p.m. P. & O. Batti-Wallahs' Society. Second Annual Dinner at Holborn Restaurant.

NOTES.

Electric Shock Fatalities.—On Thursday last week Mr. Walter Schroder resumed the inquest into the death of William Hampson, who was killed by an electric shock at the L.C.C. sub-station at Mildmay Park. Mr. B. C. Carter watched the proceedings on behalf of the L.C.C.

Mr. Cecil R. G. St. John, electrical engineer in the employ of Ferranti, Ltd., was recalled, and stated that on the 11th ult. he left deceased at work at a vice 8 ft. away from the high-tension gear, and between him and the gear there was a barrier a foot high; he could not get near to the gear without some of the attendants seeing him go, and they would want to know what his business was. In the basement three of the iron door cells were open for the purpose of ventilating and drying the cells. Deceased could have received a shock there, but to do so he must have deliberately placed his hands on the cells to come into contact with the conductors so as to receive a shock. Any person putting both his hands into the cells would get over 6,000 volts, but with only one hand he would receive 3,800 volts. Deceased could not get both hands into the cells without difficulty. There were notices warning employés at each of the cells.

William Walker, electrical fitter, employed by Messrs. Ferranti, stated that he and deceased had been working at the sub-station since October last. On 11th ult. they were conversing together about the work. He left him, and ten minutes later he was called and found him lying in the basement quite unconscious. He was foaming at the mouth and moaning as if in pain, and quickly died.

Mr. Thomas L. Horne, electrical engineer, in the employ of the L.C.C. tramway department, stated that he had examined the premises and found the switch gear in good working order. He could not find any possible chance of deceased having by any means received a shock by accident; he would get a shock by placing his hand deliberately in one of the high-tension cells, but to do so he would have to walk near the front portion of the cell and put his hand on the exposed live metal, or if he had gone to the passage behind the cells he would have got a shock, but only in a deliberate way, and not by accident. If he touched the live metal he would receive 3,800 volts, but if he touched it lightly he would get a less shock. If deceased had attempted to go on the bedplate he would have been seen by the attendants and been warned to go off at once, because he would have no business to go there.

Mr. J. H. Rider, chief electrical engineer of the tramway department of the L.C.C., stated that he would visit the sub-station occasionally, and he did so after receiving Mr. Horne's report regarding deceased's death. He entirely agreed with Mr. Horne's evidence, for he thought that it was utterly impossible for deceased to have received an electric shock by any accidental means. Deceased must have deliberately placed his hand where he ought not to have done. He found by inquiries that he made that all the regulations in regard to the sub-station were properly carried out. He had not seen a person who had been killed by an electric shock, but had seen several persons who had received electric shocks. He had himself received several. In all cases the effect was to burn the parts coming in contact with the live current. They had one employé of the County Council who received as great a shock as deceased was supposed to have received, and the effect was to burn his hands. The greatest voltage that witness had ever received was 2,000 volts, and the result was that his fingers were burnt at the seat of contact.

Dr. Spilsby stated that he had made a further examination of the skin where the hæmorrhages occurred, and found that they were more numerous than appeared to the naked eye, and must have occurred at the time of death, or within five hours of death. He was further convinced in his opinion that death was due to an electric shock. Deceased's heart was affected, and only receiving a slight shock, would be sufficient to account for death. There were several cases on record of persons who had been electrocuted, yet there was an entire absence of burns on the hands or body.

The Coroner said from the evidence given it was clear that for some reason or another deceased must have deliberately touched the conductors for they had heard that he could not have received a shock by accident. Why he should have done so there was nothing to show. The jury returned a verdict of "Death from Misadventure."

Parliamentary.—Rawtenstall Corporation.—The Standing Orders Committee of the House of Commons has decided that the Rawtenstall Corporation be permitted to proceed with its Bill, on condition that the powers to construct tramways Nos. 10, 11 and 11A are struck out.

Electric Supply Corporation Scotch Order.—The authorities of the Houses of Parliament have decided that the provisions of this Order are of such a character that it must be dealt with by way of Private Bill, instead of by provisional order.

Tramway Passenger's Claim.—A spectacle dealer, named M'Glade, claimed £50 damages from the Belfast Corporation for personal injuries said to have been received while alighting from a tramcar. It was stated by his counsel that he received an electric shock while holding the upright brass bar, and fell to the ground. Mr. A. A. Blackburn, superintendent of works, in giving evidence for the defence, said it was utterly impossible for plaintiff to get a shock as stated, for the upright was at least 2 ft. from any wire that could possibly become live. An examination of the car showed that there was no leakage. The jury found for the defendants.

Royal Commission on Canals and Waterways.—This Commission resumed its sittings at the Westminster Palace Hotel on Tuesday and Wednesday, the 26th and 27th inst. Important evidence will also be taken on each Tuesday and Wednesday following, until the 20th March.

On Tuesday evidence was given concerning electrical haulage by Prof. Marchant, D.Sc.; Mr. B. Dunell followed with evidence on behalf of the engineering section of the London Chamber of Commerce. Future arrangements have been made by the Commission as follows:—

March 5th.—London and North-Western Railway Co.; Birmingham and Shropshire Union Canals.—Sir Frederick Harrison, Mr. Jebb, M.Inst.C.E., Mr. Macpherson.
March 6th.—Great Western Railway Co.—Mr. Rendell, Mr. Grierson.
March 12th.—Midland Railway Co.
March 13th.—Great Northern Railway Co.—Mr. Bury.
March 19th.—Birmingham and Liverpool.—Mr. Kenrick, Mr. Wright, Mr. Taylor, Mr. Shepherd, Mr. Cooper.
March 20th.—Iron trade.—Mr. Jeans.

Our report of Dr. Marchant's evidence will appear next week.

Debating Club.—The first meeting of the Debating Club formed by the staff and employés of Messrs. A. Reyrolle & Co., Ltd., at Hebburn-on-Tyne, was held on February 21st. Mr. F. Coates read an instructive paper on "Current Transformers," after which a discussion on the various points ensued. We have been favoured with a copy of the rules adopted for this club. For the 1907 season, Mr. A. Reyrolle is president; Mr. F. Coates, vice-president; Mr. C. G. Rattray, secretary; and Mr. W. Harriman, treasurer.

Appointment Vacant.—An assistant lecturer in physics and electrical engineering is wanted for the Battersea Polytechnic (£180). See advertisement pages to-day.

Copper.—The position of copper is best described as steady, with a tendency to rise. At present the continued holding-off of buyers in the hope of the market easing on arrival of further supplies prevents any rapid and continuous rise in price. There is also the impression that the prosperity and activity of the last year, in the States and elsewhere, is now on the wane, and that the demand for the metal must fall in consequence. Works involving large purchases of copper, such as the conversion of a railway system to electric traction, are delayed where possible under present prices, and only the most necessary additions undertaken. Shipments which were looked for at the end of the month have been delayed owing to bad weather, and although it can hardly be expected that their influence on the market would be very pronounced, the tendency is to await their arrival.

The price for standard throughout the month has remained practically stationary in the neighbourhood of £107 5s. for cash, and £108 5s. for three months delivery, the latter quotation tending downwards. The mid-month visible supplies were 14,103 tons—that is, one-third more than for the same date last year.

The impression in America appear to be that copper will, before a decided set-back occurs, reach the neighbourhood of £140 per ton. In view of the great efforts being made by the mining companies to benefit by the high prices, and the tendency to depression in prices generally, it does not appear likely that a further rapid rise, such as would be needed to attain this price, will take place under any but artificial pressure.

Stealing Telegraph Wire.—Last Saturday at the Middlesex Sessions, George Sparkes was sentenced to 18 months and Albert Longit to nine months' hard labour for stealing telegraph wire from Twyford Abbey Farm, the property of the Postmaster-General.

Institution and Lecture Notes.—Royal Institution.—The Friday evening lecture last week was given by Mr. Dugald Clerk, whose subject was "Flame in Gas and Petrol Motors."

On Saturday last Prof. J. J. Thomson gave his second lecture on "Röntgen, Cathode and Positive Rays."

Institution of Electrical Engineers.—On Thursday 21st ult., Prof. J. J. Thomson lectured on "Modern Theories of Electric Conduction through Metals," Lord Rayleigh, Prof. S. P. Thompson and Sir Wm. Preece commenting on his remarks. It was announced that Lord Kelvin has been nominated as President of the Institution during the ensuing year.

Institution of Civil Engineers (Association of Yorkshire Students).—At Leeds on 21st ult., Mr. C. Nelson Hefford read a paper on "Electricity Generating Stations: Their Design and Equipment."

The Lights (?) o' London.—As we go to press with our last pages, our electric light has gradually faded away. First the Nernst ceased to glow, at 12.10; the carbon lamps maintained a feeble glimmer for half an hour longer, and then gave up the ghost. We are now writing by the light of a tallow candle, stuck on a cocoa tin. We thought the Charing Cross Co. welcomed foggy days! Our neighbours on the City Co.'s mains are more fortunate.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Erith U.D.C. has appointed Mr. V. H. Lowry as shift engineer at the electricity works.

Mr. John Gowen, of Rochdale, has been appointed assistant electrical engineer to the Rangoon Tramways and Supply Co.

Mr. J. S. Hollinrake, who for the last two years has been an assistant engineer at the Hebden Bridge Electricity Works, near Halifax, has been appointed assistant engineer to the Faversham Corporation.

A correspondent says that Mr. E. D. Harrot, of Walkden, sailed for South Africa last Saturday week to take up work in the corporation electrical department at Johannesburg.

The staff and employés of the Salford Electricity Works have presented a silver rose bowl and a silver cigarette case to Mr. C. D. Taite, the retiring electrical engineer, on his departure to take up a position with the Lancashire Electric Power Co.

Mr. Eustace, deputy engineer to the West Ham electrical undertaking, has been appointed engineer and manager of the Chelmsford Electricity Supply Co. Mr. Masters, resident engineer at the West Ham generating station, is to be promoted to the position of senior assistant, and his salary raised to £200 per annum. A boiler-house foreman superintendent is to be appointed at £3 a week, and a mains assistant at £150 per annum. Mr. Gilbert, mains assistant, is to be promoted to the position of mains engineer, vice Mr. Hunt, resigned, at a salary of £150 per annum, increasing to £175 in six months, if his services are found satisfactory.

Mr. R. A. Chattock, corporation electrical engineer and manager at Birmingham, was appointed to his present position in July, 1903, at a salary of £1,000 per annum. Since that time the new station in Summer Lane and the sub-stations have been erected, and the undertaking greatly developed, the whole scheme for the extension having been designed by the engineer, and carried out under his superintendence. Having regard to the growth of his duties and to his valuable services to the Department, the Committee will recommend the City Council at next week's meeting to increase Mr. Chattock's salary to £1,200 per annum as from April 1st.

We are informed that the Belfast Tramways and Electricity Committee decided at this week's meeting to take no action in the matter of appointing an electrical engineer in succession to Mr. M'Cowen, beyond raising the salary of Mr. T. W. Bloxam and instructing him to fill the position for the present.

Mr. Laverty, late with the Melrose Supply Corporation, Ltd., has been appointed resident engineer and manager of the Hitchin Electric Light Co.

The Ilford U.D.C. electricity department recently held its annual dinner, with Mr. A. H. Shaw, M.I.E.E., chief electrical engineer, in the chair.

On Thursday evening last, Mr. J. W. Speight was presented by Mr. Fred. H. Edwards (station superintendent), on behalf of the members of the staff and workmen of the Woolwich electricity department, with a marble clock, on his leaving to take up an appointment at the Leyton Urban District Council electricity works.

Tramway Officials.—The Finance Commitee of Preston T.C. has recommended that the salary of Mr. E. Lafferty, tramway traffic superintendent, be increased from £130 to £156 per annum.

The Wigan E.L. and Tramway employés have presented a gold watch chain and pendant to Mr. James Slevin, the general manager, as a token of esteem.

Mr. C. Stuart Bill has been appointed permanent way engineer under the Birmingham Corporation Tramways department, at a salary of £300 per annum. Mr. Bill was previously in charge of the road operations carried out by Messrs. Dick, Kerr and Co. for the Corporation. Mr. Richard Dickinson, who was superintendent of the repairing shop at Kyott's Lake Road depôt under the old company, has also been appointed in a like capacity under the Corporation at £250 per annum.

At a meeting of the Executive Committee of the Municipal Tramways Association at the Manchester Corporation Tramway offices, February 22nd, an address was presented to Mr. J. McElroy, general manager of the Electric Corporation Tramways, hon. sec. of the Municipal Tramways Association, 1902-6, president of the Association this year. Thanks were tendered to him for his services since the inception of the association.

General.—Mr. Fred Turner Garrett, of the firm of F. T. & A. Garrett, electrical engineers, Northampton, has been appointed a Justice of the Peace for the borough of Dunstable, of which he has thrice been Mayor.

Capt. G. B. Williams, Electrical Engineers R.E. (Volunteers), has recently returned from East Africa, where he has been engaged in reporting to the Colonial Office on the sanitary condition of various towns in the East Africa Protectorate. Capt. Williams has made various recommendations as to the engineering works necessary for the future development of the principal towns in the Protectorate.

Mr. F. B. Nathan is relinquishing the managership of the Supply Sales Department of Messrs. Siemens Bros.' Dynamo Works, Ltd., in order to take up an appointment with Messrs. Joshua Buckton, Ltd., of Leeds.

It will be of interest to our readers to learn that Mr. Herbert Briggs, Johannesburg representative of the Sandycroft Foundry Co., Ltd., has been elected a member of the Transvaal Legislative Assembly.

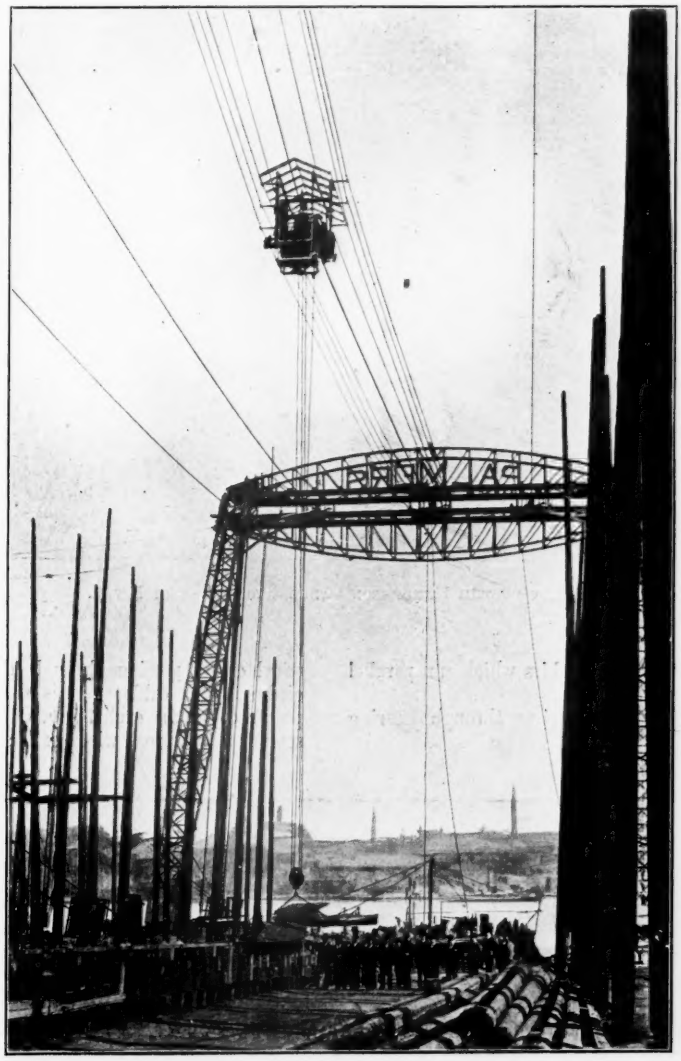
The Phœnix Dynamo Manufacturing Co., Ltd., announce that owing to the continued extension of their business, they have appointed as manager at their head office and works, Bradford, Mr. H. R. C. Partridge, this arrangement allowing Mr. Herbert A. Jones, their managing director, more time to attend to the outside business.

(Continued on page 357.)

MODERN ELECTRICALLY-EQUIPPED SHIPBUILDING BERTHS.

While Britons justly pride themselves on the position which their country undoubtedly holds as premier shipbuilding depôt of the world, it would be unwise to close one's eyes to the remarkable strides in ship construction which have taken place, both in America and on the Continent. These advances are undoubtedly greatly aided by the adoption of scientific means of construction, which it is an open secret do not always receive that consideration from British manufacturers to which they are entitled.

Few will deny the important *rôle* which electricity is now playing in connection with manufacturing and constructive operations throughout this country, and in this connection it is a matter for congratulation that shipbuilders are largely adopting electrically-driven apparatus in their yards. Few industries offer such unique opportunities for the useful employment of electrical plant, and it is safe to say that such innovations in this direction, as have been made, have met with striking success. The power equipment of shipbuilding berths is a subject, somewhat apart from yard equipments, although obviously, in the interest of economical production (or purchase of electrical energy), as full advantage should be taken of the characteristic features of electrical operation of hoisting plant on building berths as elsewhere in the yard.



Henderson's Transporter at Messrs. Palmer's Yard, Jarrow, Laying the First Keel-plate of H.M.S. "Lord Nelson."

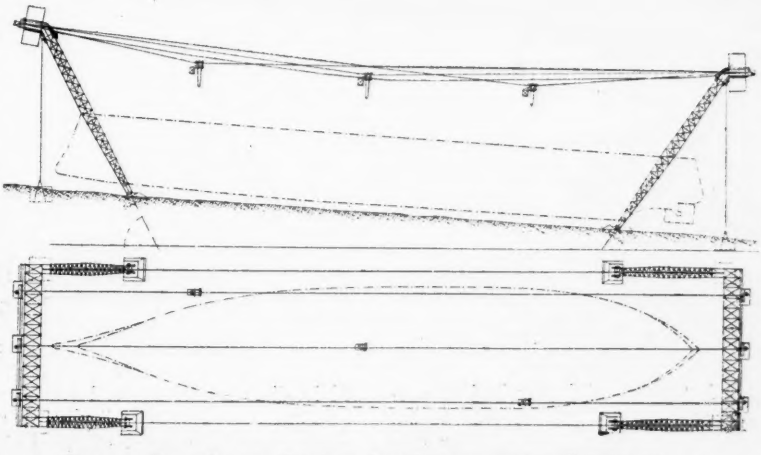


Diagram Showing the General Arrangement of the Cableways.

It is our purpose in this article to briefly describe some typical shipbuilding berth equipments in the working of which electricity plays an all-important part.

Henderson's Cableway Gear.

This plant is a novel application of the aerial transporter to the special needs of the building berth; it was built and supplied by Messrs. John M. Henderson & Co., of Aberdeen, to the well-known yard of Messrs. Palmer's Shipbuilding and Iron Co., at Jarrow-on-Tyne, the staff of the latter firm assisting in the design, which has been patented by the makers.

As a proof of the satisfaction it has given may be mentioned the fact that two adjoining berths in the same yard are to be similarly equipped.

The installation consists primarily of three aerial transporter cables lying parallel to and some 124 ft. above the building berth, and attached at their extremities to cable carriages, which move to and fro on braced steel supports. The cable carriages have a combined cross-

traverse of some 98 ft. along the cross girders forming the upper member of the end supports, which are inclined outwards from the ends of the berth, and the feet of which rest on bearings supported on masonry.

For purposes of stability, the extremities of the upper member of the supports at each end of the berth are tied together by straining cables and to the ground by vertical cables anchored at their lower ends.

A hoisting trolley runs on each of the aerial transporter cables, supported on the latter by three pulleys. Its equipment consists of a 35-H.P. three-phase 30-cycle 440-volt enclosed motor operating on the company's supply, which actuates both traversing and hoisting gears. For traversing the trolley, it actuates through gearing and a clutch two gripping pulleys in connection with two special traversing cables which run parallel to the aerial transporter cable.

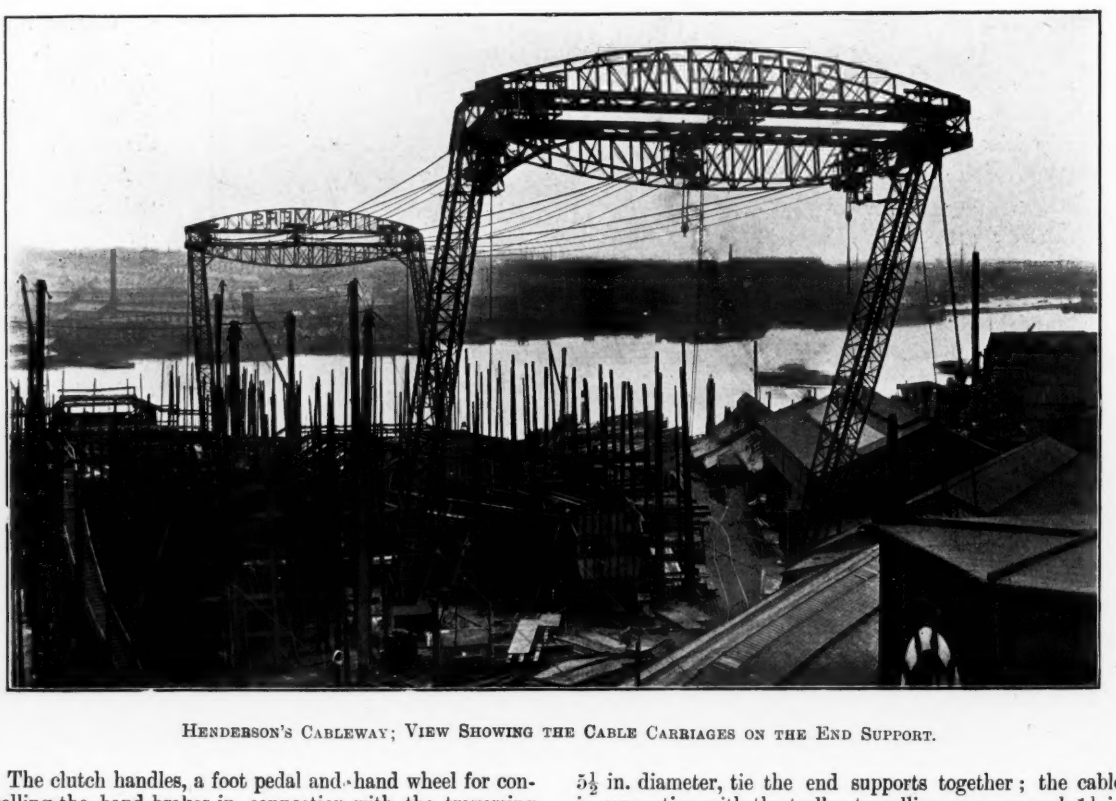
The hoisting drum is similarly driven through gearing and a clutch.

View of the Henderson Cableways from the River.

The clutch handles, a foot pedal and hand wheel for controlling the band brakes in connection with the traversing and hoisting gears respectively, and a tramway type controller are conveniently arranged for the driver's platform, the resistances being mounted beneath the motor; further, opposite the controller, is fitted switchgear for operating the motors on the cable carriages, giving lateral movements, the arrangement being clearly shown in our drawing, p. 355.

Energy is conveyed to the trolley and cable carriages by means of six aerial electrical cables, three of which run on either side and make contact with projecting collectors on the trolley.

The cable carriages at either end of the transporter cable are each operated by a 12-H.P. motor, which actuates through worm and spur gearing the vertical axles of the travelling wheels. The latter, it will be noted, run on the inner flanges of the two braced girders forming the upper member of the end supports, the transporter, travelling and electrical cables passing through the space between the two girders. The cable span is some 490 ft.; the three transporter cables are each $7\frac{3}{4}$ in. diameter, and composed of six strands of 19 steel wires each; cables of similar materia



Henderson's Cableway; View Showing the Cable Carriages on the End Support.

$5\frac{1}{2}$ in. diameter, tie the end supports together; the cables in connection with the trolley travelling gear are each $1\frac{1}{2}$ in. diameter, and the speed of travel 650 ft. per minute; the hoisting speed is 160 ft. per minute.

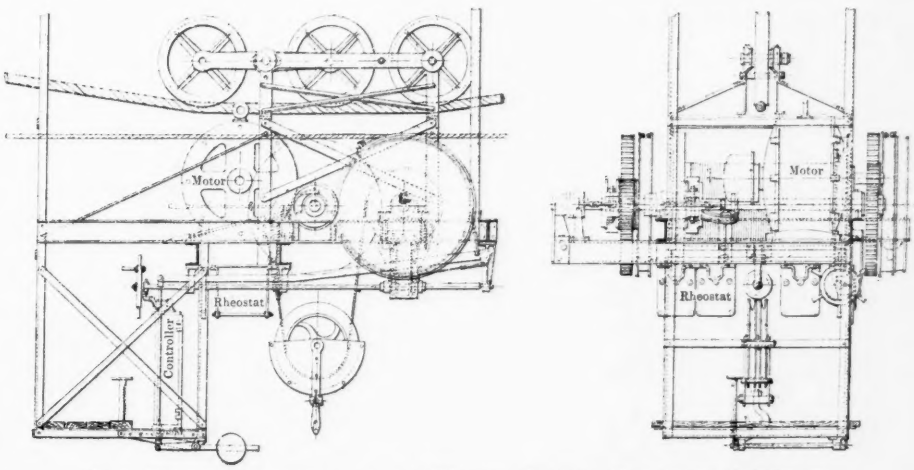
It will be noted that with this equipment the trolley driver has all his operations under his direct control, and has a clear view of the building berth, features the advantage of which are self-evident.

Electric Derricks at the Clydebank Shipyard of Messrs. John Brown & Co.

As a contrast to the equipment just described, may be mentioned the electrically-operated derricks, installed by Sir William Arrol & Co. at the Clydebank shipyard of Messrs. John Brown & Co., and herewith illustrated.

The derricks are situated at each side of the building berth, and are 100 ft. apart. They are capable of lifting a load of 5 tons to a height of 120 ft. from the ground at the rate of 90 ft. per minute and at a radius of 35 ft.

The mast is a braced column 130 ft. long × 6 ft. square in the middle and tapering to 18 in. sq. at the ends. The jib is also of square section strongly braced, and is connected by by a pin to a large worm wheel coupled to the sluing gear, which is placed on a platform 95 ft. from the ground. The lifting rope is led over a pulley at the point of the jib down the length of the jib, over a deflecting pulley at the base, and through a hole in the bottom footstep pin to the lifting winch which is placed on the ground and is operated from that point.

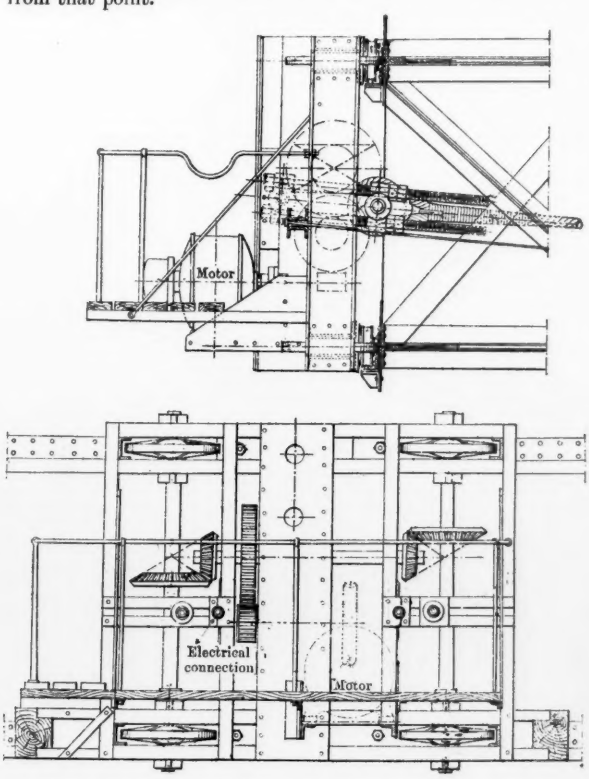


Views Showing Arrangement of the Hoisting Trolley, Henderson's Cableways.

Shipbuilding Berth Crane Equipment at the Dalmuir Yard of Messrs. W. Beardmore.

Of a different type to those previously described is the crane equipment which has been adopted by the well-known firm of Messrs. William Beardmore & Co. at their shipbuilding yard at Dalmuir, near Glasgow. This was supplied by Messrs. Applebys, Ltd., and consists of a combination of overhead travelling cranes with side walking cranes, by means of which the shipbuilding material can be quickly and easily manipulated, the cranes being used either separately for different squads of men, or in any combination for dealing with specially heavy loads.

As will be seen from the illustration, the equipment consists of a number of vertical members forming a gantry upon which the overhead travellers run, and these vertical members are rigidly held together by means of light cross girders overhead, the travellers running underneath them



Views of the Cable Carriage, Henderson's Cableways.

Arrol's Electric Derricks at John Brown & Co.'s Clydebank Shipyard.

The lifting motor is of 35 h.p., and the sluing motor of 10 h.p.

The derricks are guyed at four points, one guy being underneath the jib and three being at the top of the mast.

and commanding the whole area of the slips. The vertical members also carry rails or channels in which ordinary walking cranes can run. These cranes are arranged at either side of the structure, and are so fitted that their jibs can be swung round over a vessel under construction.

This arrangement has been found to satisfy all the requirements dictated by experience; the number of cranes employed enables an equivalent number of squads of fitters or platers to be continuously and efficiently employed, each crane being able to traverse the whole distance of the berth with its load.

Futhermore, in the case of weighty materials built into ships, these are economically handled by bringing two or more cranes to bear upon any exceptional load. Angle and plate trucks pass down each side of the berth between the legs of the vertical members and the slipway, so that there is a minimum of obstruction, the empty wagons passing up outside.

Applebys' Shipbuilding Berth Equipment at Messrs. Beardmore's Dalmuir Yard.

The lattice girders at the top may, if desired, be substituted by roof principals, so that complete protection is afforded in all weathers during construction.

In the particular equipment above referred to, the overhead travellers are electrically driven, and are proportioned for a working load of 15 tons, the span being 108 ft. and the total length of gantry 750 ft. The walking cranes are also electrically-driven, and are four in number, two on each side of the gantry, each commanding an area of 30 ft. radius.

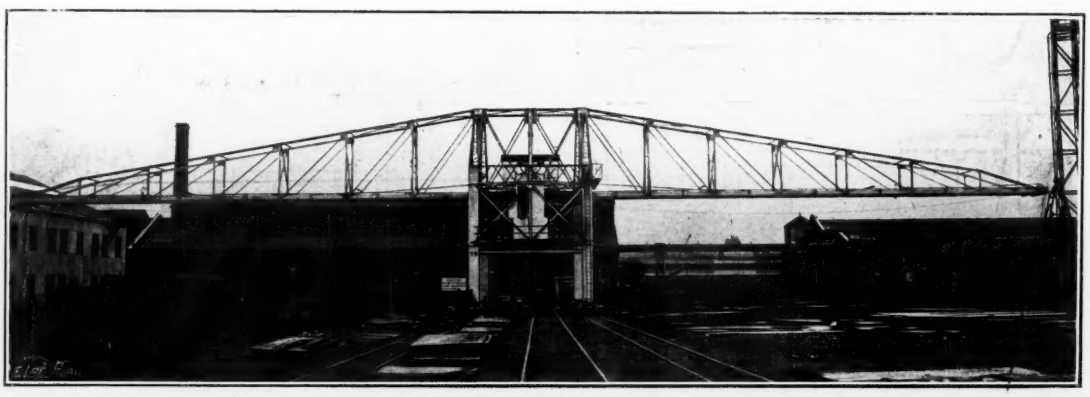
The overhead travelling crane has a vertical lifting range of 140 ft., and the lifting, travelling and traversing motions are each operated by separate motors arranged to run on a 440-volt circuit. These motors are of Messrs. Vickers, Sons & Maxims' manufacture, series wound, the lifting motor giving 50 B.H.P., running at 500 R.P.M.; the travelling motor 30 B.H.P., running at 500 R.P.M., and the traversing motor 10 B.H.P., running at about 600 R.P.M. The speeds attainable are as follows, viz.:—

Lifting, with full load, about 40 ft. per minute. Lifting, with no load, about 100 ft. per minute.

Travelling, with full load, about 500 ft. per minute. Travelling, with no load, about 750 ft. per minute.

Traversing, with full load, about 220 ft. per minute. Traversing, with no load, about 350 ft. per minute.

The cranes were tested with a 50 per cent. overload, and were specially designed and constructed for the work; the gearing being of steel cut from the solid; and special flexible steel wire rope in four parts, winding two parts, being employed for lifting. An operator's house is provided at the centre of the span, as shown in the above view. The walking cranes were constructed for a lifting load of 5 tons at a radius of 30 ft., to run on a single rail, the height between the latter and the overhead guides being 24 ft. These cranes have a wheelbase of 20 ft. and a lifting range of 125 ft.



Electric Cantilever Yard Crane Supplied by Messrs. Applebys' to Beardmore's Dalmuir Yard.

Each crane is provided with three motors for lifting, travelling, and sluing, respectively, arranged to run on a 440-volt circuit. These motors are also of Messrs. Vickers, Sons and Maxims' manufacture, and the lifting motor gives 30 B.H.P., running at about 500 R.P.M.; the travelling motor 20 B.H.P., running at about 600 R.P.M.; and the

sluing motor 5 B.H.P., running at about 600 R.P.M. The speeds attainable are as follows :—

Lifting,	with full	load,	about	60 ft.	per	minute
"	" no	"	" 150	"	"	
Travelling,	" full	"	" 250	"	"	
"	" no	"	" 450	"	"	
Sluing	any	"	" 300	"	"	

The gearing here also is of steel cut from the solid, and an operator's house is provided attached to the vertical frame as shown. Extra special flexible steel wire rope arranged in two parts, winding one part, is employed for lifting.

For the same shipyard, Messrs. Appleby have supplied a 5-ton electrically-driven cantilever crane, of special type for handling plates. The general construction will be gathered from our illustration, page 356.

The total range of traverse is 240 ft., and the clear height of lift above rail level is 22 ft. ; the crane runs on a double line of rails 25 ft. between centres, affording a wheel base of 52 ft. 3 in. The horizontal girder or beam is of the lightest possible construction, specially designed with a view to avoiding wind pressure, and is fixed upon an under-carriage mounted upon eight wheels, four of which are connected by means of gearing on one side of the crane.

The crane is provided with three motions, worked electrically—viz., lifting and traversing by a 50-B.H.P. motor, and the travelling by a similar sized motor. In the case of the lifting and traversing motions, the same motor is used, so arranged that each motion can be performed singly but not simultaneously ; the travelling motion is operated by means of a separate motor, and all the motors are operated on 440-volt circuits.

The motors are of Messrs. Vickers, Sons & Maxim's make, of the series-wound, reversible enclosed ventilated type. The speeds of the various motions with full load are as follows :—Lifting, about 100 ft. per minute ; traversing, 400 ft. per minute ; and travelling about 300 ft. per minute.

Lighter loads are, of course, lifted faster in proportion ; and by means of the controllers the speeds are capable of being varied to any desired extent.

In conclusion, although we have only been able to indicate the lines on which several of our well-known shipbuilders are proceeding, the article will serve to demonstrate the extraordinary adaptability of electrical power in such circumstances. Further, we are indebted to the several firms who supplied the apparatus for the particulars given, and would refer our readers to the description of an electrical riveter in our "Devices" column, which is also of interest in the same connection.

OUR PERSONAL COLUMN.

(*Concluded from page* 352.)

Obituary.—Our Stafford correspondent writes :—"Among the passengers who perished in the wreck of the G.E.R. steamer *Berlin*, at the Hook of Holland, were Mr. Hans Boehmlaender, who was recently appointed manager of Messrs. Siemens Bros.' Dynamo Works, Ltd., at Stafford (in succession to Mr. F. Hird), and Mr. William Renwick Watson, chief of the drawing office staff at the same works. Both gentlemen were proceeding to Germany for the purpose of having a conference with the heads of the firm there. Mr. Boëhmlaënder came to Messrs. Siemens, at Stafford, in the first instance about two years ago, and shortly afterwards married a Bavarian lady. They resided at that town until January, 1906, when Mr. Boëhmlaënder was appointed to an important post at the works of Messrs. Siemens-Schuckertwerke, at Nuremburg. He intended to bring back his wife and child to Stafford. Mr. Boëhmlaënder, who was a gentleman of splendid physique, formerly held a commission in the German army. Mr. W. R. Watson, who was 36 years of age, and leaves a widow, but no children, resided at Woodland View, Rowley Park, Stafford. For some time he lived in York Street, Rugby, and held the post of chief draughtsman at the British Thomson-Houston works, but left some months ago to return to Messrs. Siemens, by whom he had been previously employed. Born in South America, he gained engineering experience in various parts of the world, and saw service in the Soudan, where, whilst in charge of the boat-building department, he was daily in contact with Lord Kitchener. Mr. Watson's remains were brought to England on Tuesday, and were sent to Rugby for interment on Wednesday. The sad news of the tragic death of both gentlemen in the disaster to the *Berlin* caused a painful sensation at Stafford, and especially among the employés of Messrs. Siemens, by whom they were held in the highest respect and esteem."

A son of Mr. Isidor Frankenburg (of I. Frankenburg & Sons, electric wire and cable makers), Mayor of Salford, was also lost in the wreck of the *Berlin*. Electrical men will desire to offer their condolences to Mr. Frankenburg.

The death has occurred from concussion of the brain, through being thrown out of a trap, of Mr. A. E. Holt, member of the firm of Holt & Ashton, electrical engineers, 15, Cross Street, Ryde.

CITY NOTES.

Chelsea Electricity Supply Co., Ltd.

The annual general meeting was held on Wednesday at Winchester House.

Mr. J. Irving Courtenay presided, and in proposing the adoption of the report (see Electrical Review, February 22nd, p. 316), he said that since 1889, when the company was started, there had been an increase in the profits each year, and it was with great regret that he had to record a backward movement for the year 1906, the net profits available for dividends being £14,015, as compared with £16,797 in the previous year. There was a little more capital participating this year, as on the last occasion only half a year's dividend was paid on the £25,000 issued to the founders. They were, therefore, unable to recommend more than 4½ per cent. as against the former dividend of 6 per cent. That condition of affairs was due to several causes. Notwithstanding the fact that they had added to their circuits the equivalent of 11,496 8-C.P. lamps, and sold an additional 85,676 units, the gross revenue was £1,217 less than last year, and the net revenue had declined by £4,217. The working cost per unit sold was the same as in the previous year. The working costs, including those of management, compared not unfavourably with those of other London companies. The sole increase in cost occurred in a charge which was entirely beyond their control, being fixed by Act of Parliament. The rates, owing to the rise in the assessment of the company's property at the last quinquennial valuation, were increased by £2,080 and amounted to nearly ¾d. per unit sold, and there was still a further increase of about £700 for the current year. The rates paid in 1906 were £5,148, while the divisible profits earned in that year, after paying debenture interest and placing a reasonable amount to depreciation, amounted to £13,990. On each unit of electricity consumed users paid a contribution of nearly ½d. for local rates. The other causes alluded to in the report would, they trusted, be overcome in time. They hoped that the reduction in the average price obtained, amounting as it did to ¼d. per unit, which was equal to £3,445 on the present output, would bring more custom. The increase in output, although not very large, was not unsatisfactory, taking into consideration certain adverse conditions. The actual increase was 85,676 units, or 2½ per cent. on the previous year's output. A large part of this increase was due to the efforts which had been made to introduce the supply of electricity for other than lighting purposes, such as for heating and ventilating, driving motors, and charging batteries for electric carriages. As regarded the ordinary lighting business, they had suffered to some extent from the generally depressed state of the building trade and property market in London. In regard to capital expenditure, the comparatively small expenditure on mains was a direct result of the alteration they carried out some time back in their distributing system under which they were enabled to increase the pressure of supply. The effect of this alteration would be felt to a still greater extent in the future, as any further necessary extensions of mains could now be carried out at a very much lower cost than would have been the case under the earlier system of distribution. The London electrical supply companies were promoting a Bill in Parliament to give them powers of association for the purpose of effecting further economies in the cost of production and for dealing with the question of bulk supply. In regard to the L.C.C. Bill and other Bills which had been introduced, and were before Parliament, he was unable to say much at present. None of the Bills which could affect them had yet been allowed to go through Parliament. They had an influential organisation watching and dealing with those matters, and it was hoped that in the end they would benefit. If any issue should be arrived at this year it would go a long way towards putting an end to the unsettled state of the electrical business generally, and if a supply of electricity in bulk could be obtained at less cost than they could make it themselves, they should be glad to avail themselves of it.

Mr. W. R. Davies seconded the motion, and the report was adopted.

Westminster Electric Supply Corporation.

Mr. Edmund Boulnois presided on Wednesday at the offices, Eccleston Street, S.W., over the meeting of this company.

In moving the adoption of the report (see Electrical Review, February 22nd, p. 313), the Chairman said that Lord Suffield, the chairman, was unable to be present through illness. With regard to the report, they would see that they had had a very satisfactory year, and that the prosperity of the company continued. The applications both for lighting and for power purposes continued to

increase, and the addition to the supply of current last year was the largest they had had ever since they started in business. The demand, however, for current for power purposes did not appear in their district, at all events, to justify the extravagant statements which had been made by the L.C.C. and by others that the electric supply companies in London were not able to supply the industries which were clamouring for power at a low price. Well, they reduced the price last year to 1d. per unit, and yet they had not found any remarkable rush for a supply, even at that figure, which he thought customers would find in practice was lower than the rates proposed by the L.C.C. for similar purposes. With regard to the L.C.C. and their attitude towards the London Electric Supply Companies, they had put them to very heavy legal expenses in the past owing to the attacks they had made, and the L.C.C. had again that session lodged a Bill by which they sought to become the sole purveyors of electricity in bulk not for the County of London only, but also for an area outside, which amounted in all to some 450 square miles. They were asking Parliament by their Bill to make them the paramount authority for the supply of electricity in bulk to a population of about 7 million persons, and it had been stated that the ultimate cost to the ratepayers of these proposals would amount to something like £30,000,000. Well, they had to combat this gigantic proposal which was put forward by a powerful body backed by the public purse, and they had joined, therefore, with all the rest of the supply companies in London to support a Bill which, if passed, would enable them to establish a combination or amalgamation (which, by-the-by, had hitherto been forbidden by the Legislature) by which one company could help another if it was required with bulk supply. They believed that if they got their Bill by a combination of this kind they would be able to give a supply of electricity to consumers at a lower price even than the L.C.C. pretended to be able to supply at. The London Supply companies had been described in many quarters as monopolists, but that really was not so, because Parliament had provided that compe ition could take place in most districts at all events. But what a prospect it would be for the consumer of electricity if eventually the L.C.C. became the sole vendor of electricity in the Metrop lis and outside it! They had all had proof by experience of what happened when a municipality had the monopoly in the supply of anything which was necessary, and how complaints of hardship were treated by it. With regard to the future they had a stiff fight before them in Parliament this sess on, but they might rely upon the board doing all they possibly could to safeguard their interests. They would observe in the report that they had had to pay about £5,000 more for rates this year than last—a serious item. They were now paying over £21,000 a year for rates and taxes, and that represented 4 per cent. on the ordinary share capital, and unless some check was placed upon the extravagance and recklessness of municipal authorities he feared they must look forward to further increases. He need hardly point out that such heavy increased charges by the local authorities upon their industries made it difficult, if not practically impossible, for them to develop their policy of reducing the price of current to consumers. It seemed an anomaly, but it was true that they as a corporate body had no voice or control in the election of those who were responsible for the management of local affairs. All they could do was to hope that the eyes of those who had votes would be opened, or that some amelioration of the burden of rates might shortly take place. They would also see that they took a very large supply of current from the Central Co., where there was magnificent machinery of the newest type, and in future they would draw upon the Central to a large extent. If any shareholder would take the trouble to go up to St. John's Wood and visit the Central Co.'s fine station there and also the adjoining land which belonged to the company and which had not yet been built upon, he would see at once how ridiculous and wasteful it was to talk of the necessity for one great bulk station and a bulk supply authority for London. In addition to themselves there were at least seven other stations belonging to different companies capable of supplying any demand for power which was likely to arise for many years to come. In conclusion, the Chairman referred in high terms to the work of the staff during the year.

Lord Kinnaird seconded the motion.

Mr. Leake congratulated the board on the year's working, and complimented them on placing such large sums to depreciation.

Mr. W. J. Fisher asked whether the board thought it was likely that Parliament would agree to their combining in any way.

The Chairman said the electrical companies of London had always thought the restriction put on them, that they should not combine, was ridiculous. The Board of Trade knew quite well that the restrictions were not an advantage to the consumer, and there was a public Bill being brought in by the Board of Trade which would remove the restrictions to some extent.

Col. Cantley asked, if the companies became a combination, under whose control they would be then?

The Chairman said he could not answer that, but he had not the slightest doubt that Parliament would put them under the control of some one—probably the Board of Trade.

The report was then adopted, and a final dividend, making 12 per cent. for the year, was agreed to.

Metropolitan District Railway Co.

At the half-yearly meeting on the 20th ult., Sir George Gibb, in moving the adoption of the report, which we printed pretty fully in our last issue, commented upon the various expenditure items for the period, and said that the total train-mileage showed an advance of 221,470 miles. It was costly to run frequent trains, but on a railway like theirs it was absolutely necessary. Notwithstanding this greater train-mileage, the net expenses in connection with the working of the trains had been £2,462 less than in the December half of 1905, when they were working partly by steam and partly by electricity. A satisfactory feature was the reduction in the consumption of energy per car-mile. Maintenance had cost more, and he thought that this must be regarded as a permanent increase. There were now two additional rails to be maintained throughout the whole system, and the time available for the work was shorter than before, owing to the train service extending over a larger proportion of the 24 hours. The question of the wear and tear of the rails was still engaging the board's attention. Harder rails were now being used, and, although these cost more, they lasted longer. The expense of automatic signalling and maintenance of rolling stock had been greater. As to the latter, he did not think that it would be possible to make a reduction for some time to come. The estimate of further expenditure on capital account was £100,000 for the current six months and £68,000 in subsequent half-years. Included in that sum was £30,000 which they still had to pay in respect of rolling stock, and among other things the cost of reballasting and draining the railway. They had had the whole of the road bed carefully examined, and he was sorry to state that they must undertake the work in question. The outlay would be about £50,000, but it was absolutely necessary.

South Wales Electrical Power Distribution Co.

Certain statements concerning this company having lately appeared in the local Press to the effect that the affairs of the company are on the way to a satisfactory settlement, and that money is being found to carry on the operations of the concern, Mr. Chamen, the general manager, has written to the *Western Mail* to say that these statements are unfounded. There was a private meeting of the Consumers' Committee in Cardiff to consider proposals by which the Treforest generating station, on the one hand, and the Cwmbran generating station, on the other hand, might be carried on by the consumers themselves in these respective areas in order to ensure the supply being continued. It was not a meeting of the company or of the debenture-holders, and there was no representative either of the company or of the debenture-holders present. Mr. Chamen adds:—"It has been further stated that a letter was received by the Neath Rural District Council from the company intimating that the supply would be continued, and that the present contract price would hold good. No such letter has been received by the Neath Council or written by the company. Had there been any communication it would have contained information of an exactly opposite nature."

London Electric Supply Corporation, Ltd.

The meeting of this company was held on Thursday last week at Winchester House. Sir William Preece, who presided, in proposing the adoption of the report (see Electrical Review, February 15th, page 276), said that although the receipts had declined during the past year, they had still been able to maintain their usual dividend. The most encouraging feature in the report was the growth of units sold for power and lighting purposes. Electric power companies had been attacked recently on the question that they did not encourage and push the industry, but, of course, that was not true. The fact was that the public would not, and could not, see the advantages of electricity for power and lighting purposes, and he had always found from the first moment that he began to take an interest in electricity that the conservative engineer persisted in following the methods of his father and grandfather instead of adopting modern methods. Many a man lost an enormous amount of energy through the bad working of his shafts which carried the power from the workshop around the building. He had been laughed at for saying that, but when the very persons who scouted the idea tested their shafts, they came and admitted to him that they were losing 50 per cent. and 80 per cent. of their power. Another theory in the science of industrial finance, which was not appreciated in this country, was the art of "scrapping." It was far better to use modern tools which produced a double output at half the cost, than to continue with antiquated machinery. There was absolutely no need for any more new electrical Bills in Parliament. There were ample enough companies to supply the present demand for electricity. They had spent during their existence large sums of money in defending their rights, and for the last three or four years electrical companies had spent something like £100,000 a year in defending their properties, and promoters had spent during the last few years over £1,000,000 in trying to force electric companies through Parliament which were absolutely not wanted. Since about 7 or 8 years ago, when promoting electric companies was the fashion, 24 Bills had been granted for power purposes. Of that number 10 were in operation, and only one was successful, and that was because it was implanted on a good going concern. Two or three of them were on the verge of bankruptcy, and their prospects did not look very bright. Six of them were in course of construction, and eight of those Bills, although having passed through Parliament in spite of determined opposition, were held in abeyance, and some had even not passed out of the promoters' office. The position of the companies in London was so strong that 13 of them had combined, and were going to ask Parliament to grant them the same powers that had been given, and were being given, to other companies. There were, he thought, several reasons why they should combine, and they

(their own company) would be glad if when the time came for their purchase by municipalities in 1931 there was one purchasing authority established. At present the number of makers of electrical fittings, lamps, &c., was considerable, and if one single authority could control the operations of electric supply with some uniform and wide-reaching policy, and would act with some continuity of rule it would tend to diminish the present difficulty of electrical companies regarding the different lamps and fittings now on the market. Their company had laid down at their Deptford works—which were in a good position on the Thames—60,000-KW. plant, and they had room to put down 50,000-KW. more, and if it were needed, their extensive site would allow them to put down over 300,000 KW., so that altogether, if needed, they had room for 360,000 KW. Their plant was kept well up to date, and they could supply electrical energy as cheap as anybody in London. Owing to the growth of the business they were asking authority to create 20,000 £5 preference shares, but they would not be issued at present. They wanted that extra capital to fulfil their contract with the London, Brighton and South Coast Railway.

Mr. STEWART H. BAIN seconded the report, and said that they had spent on capital account £62,504, principally on the new plant for the London, Brighton and South Coast Railway contract. The gross revenue for the year was £18,000 less than the previous year. That was principally due to the termination of the London County Council contract. Their own units showed a satisfactory increase of 17½ per cent. They had paid in rates and taxes the increased sum of £4,500, which was equal to a dividend on their ordinary shares of 1½ per cent. The assessment of their undertaking was raised at the quinquennial valuation from £7,917 to £25,755. The price per unit sold for power and lighting purposes showed a slight diminution. Last year the figures were 4·19d. for light, and 1·77d. for power; this year they were 3·85d. and 1·3d. respectively, a decrease of 12 per cent. The company's costs, on the whole, might be considered very satisfactory when the large decrease in the traction units was taken into account.

The report was adopted, and a resolution was carried authorising the directors to issue the new capital of 20,000 £5 preference shares.

National Telephone Co., Ltd.

THE thirty-ninth ordinary general meeting was held on Thursday last week, at Hamilton House, E.C.

Mr. GEORGE FRANKLIN presided, and in moving the adoption of the report (see ELEC. REV., Feb. 15th, p. 276), he referred to the loss the company had sustained in the death of Sir James Fergusson, and the resignation of Sir Jas. Woodhouse. Turning to the accounts, the rate of progress had been maintained. The income accrued during the half-year amounted to £1,241,843, which compared with the corresponding period of 1905 was an increase of £115,865. An item which they always protested against, was that of Post Office royalties, and this half-year they had amounted no less than £118,499, as against £105,866, an increase of £12,633. It would be interesting for those who had followed the question of royalties paid to the Post Office, to know that the company during its 35 years existence, had paid 2¼ million pounds sterling in respect of royalties to the Post Office authorities. Working expenses had amounted to £710,492, as compared with £647,846, giving an increase of £61,645. The increase was due to charges for replacement and for renewals. During the past six months, the sum paid in rates and taxes had increased by £9,012. When they reflected what that meant to a company like theirs, one could only hope that when it passed into the hands of the Post Office, they would make such satisfactory contributions towards the relief of the rates; moreover, they had to pay such large sums without any representation on the bodies who imposed the taxes, and had no voting power. The net result for the half-year was £412,850, as compared with £372,265—an increase of £40,855. They had at their disposal, after paying out Post Office royalties and extra expenses, an increase of £40,585 for payment of dividends. The debenture and other interests had increased £10,744, and the preference and other dividends showed an increase of £22,096. The board, after serious reflection, had decided to allow the deferred stockholders to share in the extra prosperity of the company, and they had therefore increased the dividend from 5 per cent. to 5½ per cent. The tables for the completed year's working showed an increase in respect of business accrued of £224,635, the figures for 1905-6 respectively being £2,212,358 and £2,436,994. Post Office royalties had increased £25,392, and the net increase in the income was £199,243, the working expenses had increased by £127,069, and the net result for the year was an increase of £72,174. That, he ventured to hope, was not an unsatisfactory result, and showed that the very best had been done, although many great difficulties had been thrown across their path. They had carried to the reserve fund £255,000 instead of £235,000, which was an increase of £20,000. Rentals carried forward for unexpired terms—an item which really showed the true position of the company—amounted to £1,057,806, an increase of £85,306. That amount, although not actually in hand, was really an item of credit against the current year's expenses. Not only were the figures records in themselves, but they were also records as regarded the increase over the previous year's figures, and that was the best indication as to the prosperity of the company. They had 407,736 stations, which was an increase of 45,323 over last year; that figure was also a record. When the Post Office started to compete against them some three or four years ago it was said that their doom was sealed, but he would like the shareholders to know the exact state of affairs. The competition had been only in efficiency of service, and not in respect of cut-throat rates. In 1902, which was the first year of the Post Office working, the National had 40,759 more stations on their system than the Post Office, and if they prolonged those figures to 1906 they found that the National had in excess of the Post Office not 40,000 but 44,000 stations, so that during those five years, although the Post Office had built up a service with 39,000 stations, yet the National had kept just one step in advance, and at the end of 1906 they had in London 83,197 stations. They had in reserve an amount of £2,242,262, a sum which had been saved out of the profits to ensure the difference between what they might get in 1911, and what the service had cost them as it stood in their books. He read the clause relating to the taking over of the company's property in 1911, and said that the policy of the board was to only spend money which would be reproductive before then. The accumulation of a large reserve was the true strength of a company. They would see from the balance-sheet that they had an over-spent balance of £2,959,843. That meant that the company had been able to raise that sum without issuing stocks, shares, or debentures, but from within themselves. That money had been provided by the large reserve and advance rentals.

Mr. S. H. SANDS seconded the resolution, and it was adopted.

On the motion of the CHAIRMAN, seconded by Mr. SANDS, a resolution approving a deed of trust for providing a compensation fund for employés who might be thrown out of work on the transfer of the company, was carried.

W. T. Henley's Telegraph Works Co., Ltd.

THE directors' report for the year 1906, states that a net profit has been made of £63,959. After payment of directors' and auditors' fees, and debenture interest, and making sufficient allowance for depreciation of buildings, plant, machinery, &c., there remains £48,622, making, with £22,698 brought forward from last year, a total of £71,320. The directors have transferred £10,000 to the reserve account, and recommend the payment of a dividend on the ordinary shares of 15 per cent. (less income-tax), of which an interim dividend of 5 per cent. was paid on September 1st last. These payments will, together with the preference dividend for the year, amount to £49,000, leaving a balance of £22,320 to be carried forward. The dividend warrants for the ordinary shares will be posted on March 1st, 1907. The manufacture of underground lead-covered cables was commenced at the new Gravesend Works on July 1st, 1906.

Telegraph Construction and Maintenance Co., Ltd.

MR. W. SHUTER presided on Tuesday at the annual meeting held in Old Broad Street, E.C. In moving the adoption of the report (see ELECTRICAL REVIEW, February 22nd), he referred briefly to the figures in the accounts, and said that they might be well satisfied with the result of the year's work. The profits had been rather less than last year, but that was not due to their having done less work—indeed, they had done more—and it was certainly not due to their having been less successful in their undertakings. All the contracts both for laying and preparing submarine cables had been carried out by their ships with the greatest promptitude and success. The first item on the right-hand side of the accounts, namely, freehold and leasehold property premises, plant, stocks, &c., stood at a lower figure than last year. That was attributable to the fact that having completed their contracts before the end of the year nearly all the cables had gone out of the works. It so happened that on December 31st they had finished one lot of work and had not started again on another. They also disposed of one of their ships just before the end of the year with a view to re-arrangement of their fleet, their intention being to replace her with another ship better calculated to meet the requirements of the work they had in prospect. These causes tended naturally to decrease the first item in the accounts and to increase the second and third, but they would adjust themselves again in a short time. The new year had brought them fresh contracts, and both their factories were now in full swing again. During the past year they had had to deal with continual rises in materials, a condition of things which was always against contractors. Under these circumstances, they had not done badly. The new year found them in a very strong position, and the directors looked forward to the future with confidence.

Sir JAMES PENDER seconded the motion.

In reply to a shareholder, the CHAIRMAN said that the *Anglia* was sold some time ago, and they received the money for her before she left the Thames.

The report was adopted, and the meeting closed after the customary routine business had been transacted.

Tyneside Tramways and Tramroads Co.

THE half-yearly meeting was held at Newcastle-on-Tyne on 18th ult. Dr. Merz presided in the absence of Lord Armstrong through ill-health.

The directors' report for the half-year ended December 31st, 1906, stated that the surplus of receipts over expenses was £3,623, which, with the balance from last half-year of £607, made a total to the credit of profit and loss account of £4,230, and, after deducting interest on debentures, loans, &c., there remained an available balance of £2,388. Out of this the directors proposed to pay a dividend at the rate of 2 per cent. per annum (less income-tax); to place £600 to the credit of the reserve account for renewals, depreciation, and other contingencies, and to carry forward to next half-year £449. The total amount added to reserve for the year

will thus be £1,500, and that account will stand at £3,100. The whole of the track, overhead line, and rolling stock has been kept in thorough repair during the past year out of revenue. The outstanding liabilities of the company amount to £29,000, and, with the object of discharging this debt, it was proposed that £30,000 of 5 per cent. preference shares be issued at such time as the directors think advisable. Inasmuch as 5 per cent. interest has been paid on the loans, which will be paid off by the issue of preference shares, the amount available for division amongst the ordinary shareholders will not be materially affected.

	1905.	1906.
Car-miles (Tyneside Tramway Co.'s cars)	666,820	674,694
Passengers carried (Tyneside Tramway Co.'s lines)	3,809,432	4,247,955
Total traffic receipts	£20,964	£22,996
Gross profit	£5,488	£7,792

The Chairman said that the improvement reported in August had continued, and had, in fact, increased. This was owing partly, they were told, to the brisk trade, and partly to the fine weather, but also to general progress. The number of passengers had increased greatly. The three junctions with the lines of the Corporation of Newcastle-on-Tyne had all been effected, and were at work. The last—the one at Fisher Hill—was made on November 9th, and had since been working, giving a regular, though small, increase in their takings. The increase in the receipts of the company had been £2,026 for the whole year, and of this sum £1,607 was from their own lines and £419 from the running powers which they had with the Corporation of Newcastle. Of the increase, £750 was made in the first half-year, and £1,250 in the second. The expenditure had been £206 less during the same period. They had had a larger number of passengers in the same number of cars, and the mileage was 7,800 miles more. The receipts for the whole year were £22,981, and of this sum £18,472 was got from their own system by their own cars, £3,279 from the Corporation cars running on their system, and £1,229 from their cars running on the Corporation system. An important point in the report was the position of the reserve fund. Last year it stood at £1,500, and they had added £1,600, bringing it up to £3,100. He moved the adoption of the report and balance-sheet.

Dr. R. Spence Watson seconded, and the motion was carried. Resolutions, declaring the dividends as above, and reappointing the directors who retired, were carried.

A special meeting was then held, at which it was decided that £30,000 of 5 per cent. preference shares be issued at such time as the directors think desirable.

Newcastle and District Electric Lighting Co., Ltd.

The directors' report for 1906 says that as anticipated the gross receipts show a large increase, and the financial year just entered upon will show a still better increase. The profits from the Newcastle stations, after deducting directors' and trustees' fees, income-tax, &c., amount to £18,189 as against £14,835 for 1905, and the profits on the Newburn Station to £787, as against a loss last year of £766. A dividend is recommended at the rate of 5 per cent. per annum for the half-year ended December 31st (less income-tax), which together with the interim dividend paid in August makes 5 per cent. for the year, but owing to the more gradual progress at Newburn it has been found necessary to draw upon the reserve fund, which will then stand at £10,000, leaving to be carried forward to the credit of the present year's profit and loss account the sum of £2,248. In view, however, of the increased receipts and reduced costs it is not anticipated that it will again be necessary to trench upon this fund. The number of units sold during the year was 8,076,770, as against 5,533,702 for 1905, being an increase on the year of 45·9 per cent. During the month of January, 1906, 856,893 units were generated, whereas for the same month this year there were generated 1,181,908 units. The percentage of increase in profit for 1906 over 1905 is 27·9 per cent., whereas the increase in capital amounts to only 9·8 per cent. It will be clearly seen therefore that with a capital stationary (except for normal extensions), and an increasing revenue, the company should rapidly improve its position.

Charing Cross, West End and City Electricity Supply Co., Ltd.

The directors' report for 1906 first expresses deep regret at the death of Mr. Stefano Gatti, one of the founders of the company.

West End Undertakings.

	1906.		1905.
The gross earnings of these undertakings from sales of current, rents, &c., were ..	£126,146	compared with	£130,783
The expenses, including depreciation, were	84,088	,, ,,	82,086
And the net earnings were	£42,058	,, ,,	£48,647

After adding the balance of £14,437 from last year, and paying interest on the debenture stock, there is a balance on net revenue account of £42,575, out of which the preference dividend for the year has been paid (£18,000). The interim dividend paid for the first half-year at the rate of 5 per cent. per annum on the ordinary shares amounted to £10,000, and there is a balance of £14,575, out of which it is proposed to pay a final ordinary dividend for the second half-year at the same rate (£10,000), making 5 per cent. for the year, and to carry forward £4,575.

	1906.		1905.
In the West-end the company has added the equivalent of 8-c.p. lamps	57,308	compared with	43,622
Making a total now connected with the mains of	510,589	,, ,,	453,285
Which may be classified as—			
Lighting and heating	383,614	,, ,,	349,630
Motors	126,975	,, ,,	103,655
The latter expressed in h.p. being	5,079	,, ,,	4,146
Mileage of mains laid	350	,, ,,	347

The demand for electric energy is thus increasing, but owing to various causes the price obtained has decreased. As a result of the recent quinquennial assessment, the parochial rates show an increase of £3,210. Almost all the other items of expenses are lower, and the directors expect a marked saving in expenses during the current year.

A sum of £4,750, which had been reserved out of the revenue of the West End Undertakings during previous years to meet contingencies, which the board are satisfied will not arise, has been added to the amount brought forward from last year, and appears in the net revenue account. This item is independent of a similar item which appears in the City Undertaking accounts.

City Undertaking.

	1906.		1905.
The gross earnings of this undertaking from sales of current, rents, &c., were ..	£105,508	compared with	£95,340
The expenses were	57,325	,, ,,	53,341
and the net earnings were	£48,178	,, ,,	£41,999
Interest on debenture bonds and loans and the dividend on the City Undertaking preference shares absorbed	£47,687	,, ,,	£44,272
Leaving a balance of	Cr. £490	,, ,,	Dr. £2,272

which has been applied in reduction of the debt to the West End undertakings for dividends on the City Undertaking preference shares paid under guarantee now expired. This debt has been further reduced by the sum of £4,750, set aside out of revenue during previous years against certain contingencies which the Board are satisfied will not arise, and now stands at £4,406, against £9,647 on December 31st, 1905.

	1906.		1905.
In the City the company has added the equivalent of 8-c.p. lamps	41,475	compared with	70,128
Making a total now connected with the mains of	412,684	,, ,,	371,209
Which may be classified as—			
Lighting and heating	294,409	,, ,,	274,509
Motors	118,275	,, ,,	96,700
The latter expressed in h.p. being..	4,731	,, ,,	3,868
Mileage of mains laid	270	,, ,,	268

As a result of the recent quinquennial assessment, the parochial rates show an increase of £2,536, but the total costs in the City per unit generated have decreased.

Mr. Rocco Gatti has been appointed a director of the company in the place of the late Mr. Stefano Gatti, and Mr. John M. Gatti has been appointed managing director.

The report refers briefly to the arrangements that have been made with other electric lighting companies in London to form a committee, which is promoting a Bill in Parliament seeking authority to link up the mains of the several companies.

Electricity Generated, Sold, &c., in 1906.

West End Undertakings—	
Generated in B.O.T. units	9,016,231
Bought in B.O.T units	4,597,530
Sold.—Public lamps	453,993
Other sales	9,768,926
Total sold in B.O.T. units	10,222,919
Used on works, and transmission and distribution losses ..	4,290,342
Total accounted for	14,513,261
Number of public lamps	166
Total maximum supply demanded in KW.	5,853
City Undertaking—	
Generated in B.O.T. units	14,588,765
Bought in B.O.T. units	843,400
Sold	11,882,512
Used on works, and transmission and distribution losses ..	3,499,653
Total accounted for	15,382,165
Total maximum supply demanded in KW...	10,568

Scarborough Electric Supply Co., Ltd.

The annual meeting was held on February 21st.

Mr. G. Alderson Smith, in moving the adoption of the report (see Electrical Review, February 22nd, p. 318), said he was sorry that the more liberal discount allowed to consumers had not led to increased consumption. The whole situation was summed up in the report, when it stated that the receipts for energy supplied for lighting had suffered from bad trade and empty houses in the town.

Mr. A. A. Campbell Swinton, in seconding the motion, said the directors had pressure on the one side from the people of Scarborough who wished to have the price of electricity reduced, and, on the other, there was the duty which the directors owed to the shareholders, to see that the dividend was not unduly reduced. As to the future, great improvements were expected to be effected shortly in connection with electric lamps. They could not expect the price of the light to be cheaper, but if they could get more efficient lamps it would produce the same results. Recently there had been put on the market incandescent electric lamps of double the efficiency of the present lamp; that was to say, to obtain the same amount of light required just half the amount of energy. There

was not the slightest doubt that these high-efficiency lamps would be on the market in a year or two at the outside, or, perhaps, within six months, at the same price or a little more than the present ordinary incandescent lamp.

The report was adopted.

The Chairman moved the payment of a dividend (free of income-tax) at the rate of 4½ per cent. for the year, placing £500 to the depreciation fund, and carrying forward £172.

Mr. G. L. Beeforth seconded the motion, which was adopted.

London United Tramways (1901), Ltd.

The directors' report for the year 1906 shows that the operation of the undertaking during that period resulted in gross receipts amounting to 327,896, and the working and general expenses, maintenance and repairs, to £184,921, leaving, with the balance brought forward from last account, a net revenue of £144,091. After payment of debenture interest and the dividend on the 5 per cent. preference shares for the year, and providing for income-tax, there remains £33,840. An interim dividend at the rate of 3 per cent. per annum, less income-tax, amounting to £11,021, was paid in August last, leaving a balance now available of £22,820. Of this amount it is proposed to appropriate £11,970 in payment of a final dividend on the ordinary shares for the half-year ending December 31st last at the rate of 3 per cent. per annum, less income-tax, to place £10,000 to reserve fund for renewals, and to carry the balance of £849 to the credit of the next account. The reserve fund of £15,000 has been invested in first class securities, and the interest derived from the investments during the past year has been credited direct to the reserve fund. The gross receipts show an increase of £26,488, and the total number of passengers carried was 55,355,281, an increase of 6,198,142.

Sections of the company's system in Surrey and Middlesex, together about 12 miles of tramway, were completed and opened for public traffic in the months of March and May last. The earnings of these lines indicate that when completed and linked up with the County Council system in South London they will prove of the greatest value to the undertaking as a whole. The construction of the Wimbledon, Merton and Tooting extensions is progressing favourably, and it is expected that they will be ready for opening in May next. Under the Company's Act of 1902 the tramway from the south side of Hammersmith Bridge, through Barnes and Mortlake to Richmond, and there connecting with the line to Kew, was authorised. The powers sought in the same Session linking up this line with Hammersmith, were refused owing to the opposition of the L.C.C. In the following year the company applied to Parliament for sanction for the construction of an underground electric tramway for the purpose of effecting this desirable connection with the main system at Hammersmith, but were again unsuccessful. The period within which the statutory powers for the Barnes and Mortlake line were required to be exercised expired last August, and the directors deemed it advisable in the company's interests to abandon the line. The powers have therefore been allowed to lapse. Successful arrangements have been inaugurated during the past two months for the interchange of traffic by means of through booking between the company's tramways and the District and Great Northern, Piccadilly and Brompton Railways. The directors regret that Mr. Walter Abbott having to return to America, has resigned his seat on the board. The Hon. Sydney Holland has accepted a seat on the board.

The meeting is to be held at Winchester House on Monday. An extraordinary meeting will follow to approve the company's new Bill, and alter the name to the "London United Tramways, Ltd."

African Trans-Continental Telegraph Co., Ltd.

At a meeting held at 2, London Wall Buildings, E.C., the directors submitted their report on the operations of the company from May, 1898, to the present time, together with balance-sheet showing the position of the company at March 31st, 1906. No meeting has been called since that presided over by the late Mr. C. J. Rhodes on May 19th, 1898. The undertaking has from the outset been treated as the personal scheme of Mr. Rhodes, and until his death in 1902, the direction of the company was largely under his personal guidance. In 1899 he visited Berlin and arranged terms with the German Government for the construction of the line through German East Africa, and of certain branch lines in that territory, and for working such lines. The expenditure on construction and general purposes from the incorporation of the company amounts to upwards of £300,000. The shares issued at par met £226,850, and the balance, about £79,000, constitutes a debt due to the British South Africa Co. There are 73,150 shares unissued. Pursuant to the arrangement with the British South Africa Co., an agreement was made in July, 1898, for that company to work the telegraph system. Although originally made for three years, the working arrangement has been continued, and in substance is still in force. Since the conception of this company as a trans-continental line, conditions have considerably changed; transmission rates have been reduced from 8s. 11d. per word in 1892 to 2s. 6d. per word at the present time, making the raising of further capital for completing construction a matter of great difficulty, even if it be expedient. Telegraph lines are being gradually brought down from Egypt and the north, and in time, no doubt, gaps now existing will be filled and a through line established, when it may be possible to secure a share of through traffic. Further connections with coast towns, such as Mombassa and Dar-es-Salam, and the gradual development of the whole of Central Africa, will add to local traffic and provide additional sources of revenue; but a long time must elapse before it can be hoped to make the line self-supporting or profit-earning. Under these circumstances, the directors recommend that the existing arrangement with the British South Africa Co., modified as may from time to time be deemed advisable, be continued. Meanwhile the directors will endeavour to link up the system with coastal lines, particularly Mombassa-Wadilai and the contemplated German line from Dar-es-Salam. In their last report, the directors announced the construction of the main line from Umtali, in Rhodesia, to a point some 30 miles north of Bandawe, which lies about half way up Lake Nyasa, and some 350 miles north of Blantyre, in the British Central Africa Protectorate. The route of the existing line owned by the company is as follows:—

From Umtali, in Southern Rhodesia, through Tete, in Portuguese East Africa where it crosses the River Zambesi, to Blantyre, in the British Central Africa Protectorate; thence along the Western Shore of Lake Nyasa, through Domira Bay and Florence Bay to Karonga, where it leaves the lake and strikes a north-westerly course across the Tanganyika Plateau, through Fort Hill, Nyala, Ikala, Fife and Abercorn, to Kituta, which lies on the extreme south-eastern shore of Lake Tanganyika. From Kituta it proceeds in a northerly direction, roughly parallel with the lake, but a few miles to the east of it, crosses the Kalambo River into German Territory, and passes through Bismarckburg—now the local headquarters of the German East African Administration, and the seat of a native garrison officered by Germans—to Udjidji, where construction has ceased, and a station for the receipt and transmission of telegrams has been opened. A branch line 128 miles long connects Domira Bay (Lake Nyasa) with Fort Jameson, the headquarters of the African Trans-continental Telegraph Co., and the Administrative centre of North-Eastern Rhodesia. Another branch runs from Chikwawa, in the British Central Africa Protectorate, to Chiromo, on the Portuguese Frontier.

The total length of line constructed is now 1,584 miles, thus:—Trunk line, Umtali to Udjidji, 1,389 miles; branch line to Fort Jameson, 128 miles; branch line to Chiromo, 67 miles. In anticipation of the time when it may be possible to join up the line with the Soudanese telegraph system, the consent of the British Government to the passage of the line through British East Africa has been obtained.

The fourth annual meeting was held on Monday at London Wall Buildings, E.C. The Duke of Abercorn presided, and said that they had lost several substantial supporters in South Africa by death, and many things which would have been carried on with prosperity and success had therefore had to be held in abeyance. He would ask Mr. Macguire to state if there were any prospects of Mr. Rhodes's somewhat personal scheme of linking up North and South Africa by means of telegraphy ever being realised.

Mr. Robert Macguire, in seconding, remarked that the line had been completed at a point in German East Africa called Ujiji, and that the undertaking was being worked at cost by the British South Africa Co., and he regretted that there was a deficiency on each year's working, but that had been gradually decreasing. In March 31st, 1903, the deficiency was £3,592, and each succeeding year there was a deficit of £4,112, £1,710, and £1,425 respectively. When Mr. Rhodes first started working that company the cable rates were 8s. 11d. per word, which was really a monopoly charge, but the cost had since been reduced—he would not say by competition, but they certainly had to reckon with that—to 2s. 6d. per word, and therefore the prospects held out by Mr. Rhodes no longer existed, and the charge of 2s. 6d. per word was not now a commercial success. He did not know whether that condition of things would change, but he thought the scheme of trans-Continental telegraph was an undertaking which would certainly be carried out. There were certain gaps between Cairo and Cape Town. There was a gap of 320 miles to complete the line through German East Africa; and thence to Wadelai, in British East Africa, north of Lake Victoria Nyanza, was a length of 250 miles. There was already a connection between Wadelai and Mombassa on the coast, and there were only those 570 miles to complete so as to have a through connection between Cape Town and Mombassa. There was another gap from Wadelai to Gondokouro of 220 miles, and a final break in the line between Bor and Tampika, leaving some 1,020 miles to be constructed. When those remaining lines had been built, the scheme which Mr. Rhodes started would have been completed. The directors, however, did not intend to put any suggestion before the shareholders at present for its completion. Mr. Beit had left a sum of £1,200,000 to be devoted to improving means of communication in Africa, and the directors of that company would put before the trustees of that bequest, a proposal which they might consider favourably for completing that great scheme of Mr. Rhodes's in which he (Mr. Macguire) knew Mr. Beit took a great interest. He thought if the British South Africa Co. were prepared to go on with the present arrangement, it would be the best policy for the shareholders to allow that arrangement to exist and await events.

The report was adopted.

Lancashire United Tramways, Ltd.

The report of the directors to Dec. 31st, 1906, states that as this is the first balance-sheet it may be desirable to offer some explanation as to the relationship between the company and the subsidiary companies (the South Lancashire Tramways Co., the Lancashire Light Railways Co., Ltd., and the New St. Helens and District Tramways Co., Ltd.) This company owns the whole of the issued share capital of the South Lancashire Tramways Co. and the Lancashire Light Railways Co., Ltd., and over 80 per cent. of the shares of the New St. Helens and District Tramways Co., Ltd., but these companies are the actual owners or lessees of the tramways, and are the operating companies. The traffic receipts therefore go direct into the coffers of these subsidiary companies, and any profits made by them in the working of their respective systems would be paid over to this company as dividends on the share capital. The accounts of this company therefore do not show the traffic receipts, but these are published weekly in the Press. This company owns the generating station at Atherton, the sub-stations, car-sheds, &c., and supplies electrical energy to the South Lancashire Tramways Co. at a price, which, though equitable for a supply of this character, with the rents, &c., this year absorbs practically the whole of the profit on the tramway undertaking for the period under consideration. No details of the results of the actual operation of the tramways are given, as the period covered includes only three

winter months working of the extensions, and the balance-sheet of this company covers a different period from that of the balance-sheets of the subsidiary companies. These details will, of course, be given in future reports. The net working profit for the period covered by the profit and loss account amounts to £7,693, and after payment of the prior lien debenture stock interest there is a balance of £317. The profit only covers the period of trading from March 1st, 1906, this being the date on which the assets of the old company were conveyed to this company, the profits prior to this date being taken into the purchase account. The extensions of the South Lancashire Tramways Co.'s system, which have involved large additions to this company's buildings, plant and machinery, now prove an increased source of revenue, but inasmuch as these extensions were not completed until the end of September, the profit and loss account now presented only includes the increased revenue for a very short period. The issue of £250,000 prior lien debenture stock which was contemplated in the scheme of reorganisation passed by the debenture-holders of the old company, was successfully made, and the whole amount has been paid up. The final accounts for the extension works have not yet been made up, but there is every indication that the cost will be well within the estimates put forward in the prospectus offering the prior lien debenture stock. The negotiations with the St. Helens Corporation for a new lease of the tramways in St. Helens having failed, the directors offered to purchase the shares in the New St Helens and District Tramways Co., Ltd. A large number of shareholders availed themselves of the offer, and in consequence the company now hold over 80 per cent. of the capital of the St. Helens Co. In addition to the scheme of extension outlined in the prospectus, the company has acquired, through its ownership of the South Lancashire Tramways Co., a lease of the tramways belonging to the Farnworth U.D.C. The tramways comprise about 7 miles of track, and provide additional connections with the Bolton Corporation Tramways. The rolling stock has been purchased from the Council at a cost of about £8,000, which has been provided out of the proceeds of the debenture issue. Arrangements have also been made for acquiring a lease of the Clifton Light Railway (about a mile in length) which, when completed, will provide another connection between Bolton and Manchester. The total track mileage now controlled by the company, including the St Helens Tramways and the Clifton Light Railway, amounts to 74 miles.

The Hon. Arthur Stanley presided at the second ordinary general meeting held at Liverpool, on Friday, and moved the adoption of the report. At the outset he offered an explanation as to the relationship between the company and the subsidiary companies, and stated that in addition the company had acquired through its ownership of the South Lancashire Tramways Co. a lease of the tramways belonging to Farnworth U.D.C. This system comprises 7 miles of track, and intervenes between the Bolton Corporation tramway system and the South Lancashire Tramways Co.'s line which connect to Manchester. The company has also acquired a lease of the Clifton Light Railway, which will again form another connection between the old Farnworth system and the Salford Corporation tramways. So that when this is completed, the United Tramways Co. will provide the shortest and most direct tramway system between Bolton, through Farnworth to Manchester. By these various arrangements the company now own or control the whole of the tramways connecting Liverpool to Bolton and Manchester, with three distinct connections at the Manchester end, and they also connect with Wigan. Turning to the accounts, it was shown that the net working profit amounted to £7,692, and as the whole of the system had only been in operation in its entirety for three winter months, the chairman thought that was certainly satisfactory. As far as they had gone, the new lines had fully come up to their expectations. They, of course, could not tell what they were like until the summer months, but if they had a fairly good summer—if they did not have an experience like Christmas when it cost them £800 in two days—he hoped they would not come empty-handed before the shareholders next year. Before sitting down the chairman said the company was very much indebted to the services of Mr. Salter, the general manager.

Notting Hill Electric Lighting Co.

Sir Wm. Crookes, F.R.S., presided at the meeting held at Winchester House, on Tuesday.

In moving the adoption of the report (see Electrical Review, February 22nd, p. 313), he said that the share and loan capital had not been altered in any way, but by husbanding their resources and using their depreciation fund, they had been able to proceed since the year 1904 without any further issue of capital. The capital account gave the details of the additional capital expenditure made during the year, amounting to just under £3,000, the smallest amount of capital expended in any one year since the company commenced serious business. Over £2,000 of the new capital went on mains which had all been laid to connect up new customers, and to strengthen some of the old supply mains which were becoming almost over-loaded. The total capital expenditure to date was £231,358, and the capital receipts were £208,000. The receipts on the revenue account showed an increase of £1,600, but the net profit was only a few pounds higher than the previous year. This was due to two causes; the first, by the Wood Lane costs which had increased by reason of interest and sinking fund on account of the new station which was being erected there to meet the anticipated increase in the demand for current. Although this was not in working order the two companies had to bear the expenses of the interest on the debenture stock and contribution to the sinking fund. The second cause had been the rise in rates paid to the local borough councils, which showed an increase of £500, and a total of £2,325, which added to the proportion of rates paid on the joint works brought their contribution in local rates to over £3,000. This was a very high figure, and represented nearly ½d. on every unit of electricity sold. If they took the accounts of the local authorities supplying themselves in districts which fixed their own assessment, they would find the rates worked out at considerably less than ½d. per unit. The net revenue account showed that the balance and profit with a small amount of interest received, brought the total to be dealt with up to £20,039, and on the debit side it would be seen that they had taken £3,300 of the profit for depreciation and sinking fund, and the debenture interest had absorbed £4,541, leaving £12,194 for division amongst the shareholders. The depreciation, renewals, and reserve accounts showed a balance of £25,532, after writing off a small amount of loss on some obsolete meters which had been sold. The Kensington and Notting Hill joint debenture stock sinking fund account showed that they had contributed over £6,000, and this appeared likely to provide a substantial surplus at the end of the period for division between the two companies, as the sinking fund worked out at about 3¾ per cent., and was calculated at 3 per cent. They had generated and purchased 2,566,425 units, but the total quantity accounted for was only 1,816,354 units, showing a loss of about 30 per cent. in transformation, distribution, &c., which was much higher than the percentage in more compact districts. It was, however, unavoidable, owing to the great length of their supply mains. The company had steadily increased its dividends, and from a loss of £550 in the year 1891, they made a profit of £20,000 in 1906. It would be remembered that various electrical Bills were introduced into Parliament last year, which were not allowed to be proceeded with, and they would have seen by the report that the company had joined with the other electricity companies in the promotion of a Bill which, if passed, would enable the companies to meet every demand for electricity for all purposes, and to charge customers a reasonable rate for the supply. It had been freely said that there was an enormous demand for electricity in London for power purposes, but it had been shown by systematic canvass that the demand had been enormously overstated. In their district there was little demand at present, although they had done all in their power to develop and encourage it. The Bill would enable the companies to amalgamate, and more clearly define the conditions of purchase at the end of their term, which it was suggested should be extended from 1931 to 1949, in consideration of the companies accepting the obligation to supply electricity in bulk for power purposes at the low prices stated in the Bill. Considerable economies would be effected by allowing the companies to amalgamate or link up, and a large amount of spare plant which the different companies had been compelled to keep, could be used to meet increased demands without the necessity of raising new capital. The result would be to benefit the consumer in a reduction of the charge. The London County Council had also introduced a Bill, and although it was said that this would not injure any of the existing companies, they did not feel satisfied about it, and they were opposing it. The business which the L.C.C. could get would be probably carried on at a loss and would be detrimental to the interests of London, and unless modified would prevent the development of the power business of electric lighting companies. The companies had been put to enormous expense in opposing the various power Bills brought before Parliament for several years past, and it was hoped the question would be definitely settled at an early date. There appeared to be a general idea that the companies were making enormous profit, but if they went into the figures they would see that the dividends paid on the capital invested since 1888 did not amount to a very high rate of interest, and in the case of their own company, it was less than an average of 4½ per cent. Another fallacy was the statement that if electricity only cost 1d. a unit to make, it ought to be sold at 1½d. per unit. Those who made the statement appeared to overlook the fact that it cost as much, or nearly as much, for distribution as to make it, and there was also the loss and the rates to which he had alluded. With a settlement, however, of the questions now before Parliament, he looked forward to the future with confidence.

Mr. A. E. Franklin seconded the motion.

Mr. Makins asked if the board did not feel that the founders' shares should be converted.

The Chairman said the founders' shares did not take a great deal of money from the company, and it had to be remembered that in the inception of the company there was no plundering. It was a clean company, and the founders found the money to work the business, and were only now beginning to get a return.

The report was adopted.

Yorkshire Electric Power Co.

Mr. A. G. Lupton presided at the half-yearly meeting at Leeds on 19th ult., and in moving the adoption of the report (see Elec. Rev., February 8th) he said that a year ago it was told them that they would shortly have to borrow upon debentures. The time had come, but as the money market was not in a favourable position for a public issue or an issue to the shareholders, they had made a temporary arrangement with their bankers, who had lent £30,000. The £5,076 capital expended during the half-year had been spent on cable extensions, connections, &c., in places where they had consumers. The working expenses for the half-year were £5,187, and the receipts £3,523. The company was steadily progressing,

but its progress was not so rapid as some had hoped it would be at the beginning. They knew already that the sales of electricity for 1907 would very greatly exceed those for 1906. Their district was entirely different from the South Wales district; they were not dependent on any one industry. They had got a good plant, which was running well, and had not had to scrap a single bit of plant, and they were getting customers very rapidly wherever their cables went. Since the report was issued they had made an agreement for over 300 KW. with new consumers.

In reply to questions, it was stated that if the output were taken for the last month it would seem that it had already increased to the rate of 2,000,000 units a year, and it was estimated roughly that about 3,500,000 units would fully cover all expenses and outgoings, and Mr. Woodhouse, the engineer, considered that that amount would practically be reached when all the consumers with whom agreements had been made were put on. By the end of this year it might be taken as definitely certain that everything would balance out; then they would go forward to profit, and with only one-third of the station loaded.

The report was adopted.

Yorkshire (West Riding) Electric Tramways Co., Ltd.

Mr. H. S. Leon presided at the second annual meeting held at 14, Victoria Street, S.W., on Friday last. In moving the adoption of the report (see Electrical Review, February 22nd, page 317), he pointed out that £5,000 had been placed to depreciation as against £3,000 in 1905. The receipts per car-mile continued low, but they showed a little improvement. They had increased by ·524d. to 7·708d. From the commencement of last year for the first ten weeks they had shown an increase of £205 per week consequent upon the opening of a new section, but that had not continued throughout the whole of the year. The total increase on that section for the year was £4,792, or £92 (average) per week. The working expenses remained remarkably low (3·963d. against 3·745d. in 1905). This increase was due to expenditure upon road maintenance for which they spent £2,070 compared with £296 in 1905. The road maintenance per car-mile was ·351d. against only ·056d. in 1905. Other items of expenditure had been reduced. It was estimated that the cost of maintaining the macadamised roads was £3,000 per annum, and that was an estimate for forthcoming years, and it showed that it must be more economical if possible to as quickly as possible pave the roads with granite cubes. With that in view, in order to lessen annual expenditure, the board decided to put aside each year £5,000 for the purpose. As that was done the expenditure on macadam would be less and less. The percentage of expenses to receipts was 51·40 per cent. as against 52·46 per cent. in 1905. The service now running was capable of carrying twice as many passengers without any increase of working expenses. The new route of tramways between Normanton, Castleford, and Pontefract (seven miles) were opened in October and promised to become profitable, and the board was more than satisfied with the traffic so far obtained thereon. The staff now consisted of 287 persons, an increase of 67 for the year. Turning now to quite a new subject, he said that a company called the Lofthouse Park Co. had been formed, owning about 50 acres of land midway between Leeds and Wakefield, and the object of the company was to develop that land as a place of public amusement. The company's tramway ran between the two cities. Every person who visited the park would be a profit to the tramway company. Residents were looking forward to the opening. Under these circumstances, the board had come to the conclusion that it was of such paramount importance that that place should not only exist, but that it should be opened and made as attractive as possible as quickly as possible, and so the board decided to take £4,500 in second mortgage in the Lofthouse Park Co., and if it thought it expedient, to subscribe for the necessary number of shares over and above those already taken by outsiders in order to equip the park and open it. But, as all this took money, he referred them to the capital account, while he explained the position. For that purpose he proposed to leave out the item of ordinary shares entirely, and take only the two items of debentures and preferences which amounted to £506,305. That represented money actually spent, but to that must be added a debt now owing of £50,000—mostly owing to the contractors on account of the new route between Normanton and Pontefract, and some of it for the £4,500 lent to the Park Co. on second mortgage, and some of it for money which they proposed to subscribe for shares in the Park Co. Therefore it might be taken that when that £50,000 was paid, the business represented a cash outlay of £556,000. Of that sum £446,000 had been spent on construction, and £110,000 in paying vendors, law and Parliamentary charges, commissions, and such like things. His object in giving them these figures was to show what real tangible security there was for the debentures, and consequently to give himself an opportunity of showing them the necessity of raising more money. £275,000 had been borrowed representing the amount of the debentures borrowed on the product of the labour and material costing £436,000, consequently they had a security, moreover, the goodwill of a running and improving business, and also the security of the Acts of Parliament, which could not be obtained to-morrow under a cost of £50,000. The security, therefore, so far as the debentures were concerned, was quite good, and should in the course of a few years become a gilt-edged investment, but there was no more margin for further borrowing under that head, although they had power to raise another £125,000. How were they to deal with that debt of £50,000? Upon the position of the shareholders depended greatly the answering of the important question as to the payment of the dividend on the preferred shares. The board was quite conscious of the fact that it was not a satisfactory state of affairs to have large arrears of cumulative dividends to make up. It also had to recognise that it was not possible—and if possible, not right—to borrow more on the first debentures. How were they, then, to raise the money? They had gone into the figures carefully, and he had come to the conclusion that, if he could borrow about £30,000, and if the traffics improved, he might say that when they met next year there should be a substantial cash dividend for the preference shareholders. Had it not been for him personally that tramway would have failed in its construction—in fact, it would have gone into liquidation. He did not feel inclined again by himself to step into the breach and lend the whole of that £30,000 except on such onerous terms as he would strongly advise the company not to listen to, but he was quite willing to co-operate with his colleagues, who were large preference holders like himself, and finance the company on such satisfactory terms as would suit those who lent the money on the one hand, and on the other would place the company in a position to pay a cash dividend on the preferred shares at the end of this year if that cash dividend were earned. For that purpose he proposed to the shareholders, without prejudice, that the preference shareholders lend that £30,000 at 6 per cent. to be paid off at the rate of not less than £2,000 every year out of the earnings, thus paying the whole off in fifteen years, or at any time, and take a second mortgage or notes as security for that loan, those notes ranking after the first debentures. In a very short time the board would prepare a circular which would put the case fully before the shareholders. He himself would be personally prepared to lend £5,000 on those terms.

Mr. E. Schenck seconded.

Some questions were asked by a Shareholder who wished to know the length of the lines finished and unfinished respectively, his object being to compare the estimate in the original prospectus with the expenditure which had been actually incurred for the lines now running. It was stated that 40·382 miles were running, and that there was no track now laid down that was not working. They had powers for other lines.

The report was adopted and the retiring directors and auditors were re-elected.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—

Baker Street and Waterloo Railway Co.—Further issue of £160,000 perpetual 4 per cent. debenture stock.

Compania de Gas y Electricidad de la Habana.—£150,000 5 per cent. bonds of £100 each, Nos. 1 to 1,500.

Lanarkshire Tramways Co.—28,723 shares of £10 each, fully paid, Nos. 1 to 28,723.

Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—

Anglo-Malay Rubber Co., Ltd.—Further issue of 10,000 shares of £1 each 12s. 6d. paid, Nos. 140,001 to 150,000.

National Telephone Co., Ltd.—Further issue of £500,000 deferred stock.

Rosario Electric Co., Ltd.—15,000 6 per cent. cumulative second preference shares of £5 each.

Metropolitan Electric Supply Co.—The directors recommend a final dividend for 1906 of 4s. on the ordinary shares, making a total distribution for the year of 8s. per share, or 8 per cent. In the previous year the dividend was 10 per cent.

City of Buenos Ayres Tramways Co. (1904), Ltd.—Mr. E. H. Woods, presiding at the meeting held last week, said that the prosperity of the company was bound up with that of the Anglo-Argentine Tramways Co., which was doing a splendid business. The net revenue for the twelve months under review amounted to £65,634. The quarterly dividends for the nine months to September 30th had absorbed £46,500, and the board proposed a balance dividend of 1s. 3d. per share: £3,500 was to be transferred to the fund for the redemption of share capital, which now stood at £14,173. The amortization for the debenture stock stood at £12,258.

Blackpool and Fleetwood Tramroads Co.—Presiding at the annual meeting on Friday, Mr. George Richardson said that the year had been a record one for them. Including the sum brought forward from the last half-year (states the report), the balance of profit made by the company, after providing for debenture interest, is £11,201. The directors recommended a dividend for the half-year at the rate of 8 per cent. per annum, leaving a balance of £2,201 to be carried forward. During the half-year 1,830,093 passengers were carried, and the receipts from all sources amounted to £24,532. Last year the dividend was at the rate of 9 per cent.

County of London Electric Supply Co., Ltd.—The directors have decided to recommend payment of final dividends upon the preference shares at the rate of 6 per cent. per annum for the half-year ended December 31st, 1906, less income-tax, and on the ordinary shares at the rate of 6 per cent. per annum, less income-tax, for the same period, making 5 per cent. for the year on such shares. The sum of £21,000 has been placed to reserve for depreciation and about £5,000 carried forward. Last year the same dividend was paid.

Mexican Light and Power Co., Ltd.—The directors in their report for 1906 state that during that period the gross earnings were $3,854,194, and the operating expenses were $1,476,975; $113,323 was applied to maintenance of plant and $1,075,286 carried forward.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	*	No. of wks.	Total to date. £	*	Route miles open.	*
Aberdeen	Feb. 20	2,331	+ 47	37	53,962	+ 1,812	14·4	..
Ayr	,, 16	326	— 24	40	12,014	+ 23	8	..
Bath	,, 20	1,19	+ 15	8	4,829	— 162	13	..
Belfast	,, 22	6,314	+ 626	8	..	..	40	+ 6½
Birkenhead	,, 24	1,907	+ 69	47	49,280	+ 841	13·52	..
Birmingham	,, 16	10,483	..	46	85,331	..	..	..
Blackburn	,, 20	1,712	+ 86	47½	48,354	+ 2,945	13·6	..
Blackpool Corp. ..	,, 21	661	+ 23	45	51,477	+ 3,627	11·87	..
,, —Fleetw'd	,, 23	354	— 15	7	1,436	+ 25	8·25	..
Bolton	,, 24	3,816	+ 229	47	99,324	+ 7,232	26	+ 1
Bournemouth ..	,, 20	2,446	— 47	46½	75,806	+ 9,824	21·5	+ 1½
Bradford	,, 23	7,980	+ 141	47	200,382	+ 7,350	53	+ ·7
Brighton	,, 24	1,327	— 71	47	44,928	..	9·5	..
Bristol	,, 22	9,110	— 101	..	..	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	,, 15	430	+ 10	6	1,407	— 21	3·65	..
Barnsley	,, 15	303	— 2	,,	944	— 30	..	..
Barrow	,, 15	403	— 7	,,	1,311	+ 8	5·37	..
Cavehill	,, 15	99	+ 19	,,	805	+ 88	..	..
Devonport	,, 15	772	— 1	,,	2,721	+ 43	8·85	..
Gateshead	,, 15	1,891	+ 78	,,	6,056	+ 80	11·25	..
Gravesend	,, 15	381	+ 1	,,	1,251	— 26	6·5	..
Greenock	,, 15	1,149	— 13	,,	3,591	— 68	7·25	..
Hartlepool	,, 15	479	— 11	,,	1,483	— 164	6·72	..
Kidderminster ..	,, 15	167	— 9	,,	539	— 49	..	..
Leamington	,, 15	242	+ 15	,,	8 2	— 20	3	..
Merthyr	,, 15	370	+ 28	,,	1,081	+ 65	2·9	..
‡Metropolitan ..	,, 15	6,753	+1,486	,,	22,759	+ 4,923	22	..
Middleton	,, 15	552	+ 34	,,	2,773	— 13	8·5	..
‡Mid. Joint Com'tee	,, 15	12,017	— 478	,,	37,996	— 2,118	..	..
Oldham — Ashton	,, 15	1,085	+ 98	,,	3,479	+ 204	9·13	..
Peterborough ..	,, 15	187	+ 3	,,	598	— 31	5·31	..
Potteries	,, 15	3,420	+ 68	,,	11,285	— 52	29	..
Rothesay	,, 15	86	+ 13	,,	299	— 5	2·75	..
Southport	,, 15	378	— 53	,,	1,252	— 213	8·17	..
S. Metropolitan ..	,, 15	1,152	..	,,	3,951	..	..	..
Swansea	,, 15	1,478	+ 76	,,	4,891	+ 126	5·5	..
Tynemouth	,, 15	273	— 26	,,	910	— 127	3·75	..
Weston-s-Mare ..	,, 13	45	— 3	,,	151	— 12	3	..
‡Worcester	,, 15	425	— 22	,,	1,440	— 111	5·75	..
Wrexham	,, 15	171	— 1	,,	554	— 28	..	..
Yorks. Wool. Dist.	,, 15	1,679	+ 109	,,	5,484	+ 199	17	..
Miscellaneous ..	,, 15	350	— 2	,,	1,112	— 56	..	..
Burnley	,, 23	2,156	+ 32	..	..	..	7·5	..
Burton-on-Trent ..	,, 24	511	— 2	47	13,291	— 511	10	+ 1.5
Bury	,, 17	1,724	..	46	44,523	..	10·5	..
Cardiff	,, 16	3,565	— 35	46	94,817	+ 1,174	15·87	..
Carlisle	,, 23	277	— 14	8	1,107	— 151	..	..
Chatham and Dist.	,, 21	1,228	+ 165	8	4,489	+ 110	12·84	+ 3·5
Cork	,, 21	790	+ 7	8	2,975	— 134	9·89	..
Croydon	,, 22	2,315	+ 84	38	53,835	+ 4,100	12	+ ·75
Darlington	,, 23	392	+ 17	47	9,827	+ 295	..	..
Darwen	,, 23	446	+ 7	47	11,870	+ 484	4·36	..
Dover	,, 23	323	— 15	47	11,519	+ 1,080	4·75	..
Dublin	,, 22	9,054	+ 282	8	31,734	+ 1·9	54·25	+ ⅝
Dundee	,, 20	2,015	+ 143	38	44,005	+ 6,341	13	+ ·1
East Ham	,, 23	1,648	+ 144	47	41,866	+ 3,130	8	..
Exeter	,, 22	466	+ 18	47	13,633	+ 530	4·75	+ ·5
Glasgow	,, 23	32,075	+1,563	40	644,235	+51,741	36·75	+10½
Hastings	,, 21	1,325	..	..	..	..	..	..
Huddersfield ..	,, 23	2,776	+ 224	47	70,708	+ 5,880	28	..
Hull	,, 23	4,662	+ 375	47	109,470	+ 4,674	13	..
Ilford	,, 23	811	+ 62	47	22,145	+ 396	6·37	..
Ilkeston	,, 20	247	+ 24	47	6,179	+ 642	3·5	..
Ipswich	,, 23	603	— 8	47	19,516	— 125	10·5	..
Isle of Thanet ..	,, 23	429	— 15	8	1,676	— 126	11	..
†Kilmarnock ..	,, 16	145	+ 5	40	6,163	+ 104	4·25	..
Lan'kshire Trm. Co.	,, 21	2 028	+ 376	8	7,204	+ 647	15·82	+ 3½
Lancashire United	,, 20	2,066	+ 527	8	7,418	+ 1,731	87	+ 9
Leeds	,, 16	12,599	+ 830	44	287,160	+17,223	96	+ 6·5
Leicester	,, 23	4,059	+ 140	..	..	..	..	..
Leith	,, 16	930	+ 91	40	20,389	+ 5,933	6	..
Liverpool	,, 16	20,089	+ 217	7	69,613	+ 1,039	104	..
‡L.C.C.	,, 9	50,245	+22,770	45	1,176,597	+517,350	115½	+62½
London United ..	,, 22	10,030	+1,250	7⅛	87,513	+ 2,657	..	..
Lowestoft	,, 23	266	+ 48	21	3,277	+ 337	..	..
Manchester ..	,, 23	26,300	+2,811	47	645,512	+45,494	146	+21
†Newcastle	,, 16	3,890	+ 319	46	186.160	+11,931	..	..
†Newport	,, 16	570	+ 36	46	28,833	+ 1,802	14·5	..
Northampton ..	,, 22	741	+ 56	46	20,243	+ 461	5·5	..
Oldham	,, 24	3,378	+ 331	48	85,677	+ 7,685	23·75	..
Pontypridd	,, 24	312	+ 24	47	7,805	+ 398	3·5	..
†Portsmouth ..	,, 23	1.335	+ 26	47	90,546	+ 407	14·5	..
†Preston	,, 20	1,306	+ 151	..	..	..	10	..
Reading	,, 21	1,072	..	47	29,407	+ 354	..	..
Rochdale	,, 19	958	+ 152	..	..	..	20·6	..
Rotherham	,, 21	1,089	+ 248	47	23,803	+ 2,456	10	+ ·67
Salford	,, 18	8,211	+ 286	46	205,925	+ 6,317	38·9	..
†Sheffield	,, 17	5,178	+ 294	47	249,400	+17,318	35·75	..
Southampton ..	,, 20	1,610	+ 2	46	44,525	+ 35	..	..
†Southend-on-Sea ..	,, 13	234	+ 8	46	17.834	+ 959	6	..
Sunderland	,, 24	2,486	+ 177	47	65,341	+ 3,426	..	..
†Swindon	,, 13	132	— 15	..	..	..	4·4	..
†Tyneside	,, 20	751	+ 75	8	2,636	+ 178	8·87	..
Walthamstow ..	,, 23	724	+ 58	47	26,127	+ 2,500	9	..
West Ham	,, 21	4,134	+ 514	47	105.189	+18,838	14·7	..
Wolverhampton ..	,, 20	1,058	+ 69	46	39,165	+ 1,625	12·5	..
Yorks. W. Riding ..	,, 24	2,076	+ 530	8	7,811	..	..	..
Baker St.-Waterloo	,, 23	4,840	..	8	14,071	..	3·75	..
Cen. London Rly. ..	,, 23	12,693	—1,800	8	51,265	— 4,500	6	..
City & S. Lon. Rly.	,, 24	6,123	+ 85	8	24,856	+ 586	6·25	..
†Dublin-Lucan Rly.	,, 22	176	+ 1	8	650	— 20	7	..
G.N. and City Rly.	,, 23	3,768	+ 3	8	15,271	+ 116	3·5	..
G.N., P'dy. & Bromp.	,, 23	7,700	..	8	29,359	..	9	..
L'pool Overh'd Rly.	,, 24	2,702	— 25	8	10 881	— 217	6·8	..
Mersey Railway ..	,, 23	3.600	+ 132	8	14 569	+ 565	4·5	..
Metropolitan Rly. ..	,, 24	29,670	—3,410	8	122.094	—12,825	70·5	..
Met. District Rly. ..	,, 24	16,082	— 528	8	63,526	— 2,069	24	..
Anglo-Argentine ..	,, 25	32,287	+2,993	8	122,644	+ 5,664	43	..
§Auckland	,, 1	10,478	+ 696	4½	12,218	+ 254	19·24	+ ·6
§Brisbane	Jan.	12,465	+1,449	..	..	..	..	..
§Brit. Columbia Rly.	Nov.	20,034	+5,941	22	101,258	+18 188	..	..
Bu'n's A'r's E.T.Co.	Jan. 26	3,178	+ 611	4	6,587	+ 1,020	24	..
Bu'n's A'r's-Bigr'no	Feb. 17	7,438	+ 533	7½	25,553	+ 1,677	..	..
Calcutta	Feb. 23	6,562	+ 702	..	..	..	..	..
§Cape Electric T. Ld.	Nov.	14,396	..	..	..	..	..	..
§Geneva	Jan.	7,792	+ 113	..	..	..	..	..
§Kalgoorlie, W.A. ..	Jan.	3,777	..	4	3,777	..	30·5	..
Madras	Feb. 15	1,103	+ 114	..	3,429	+ 88	12·75	+ 3·5
§Lisbon	Nov.	5,582	..	..	..	..	..	..
§Mexico	Sep.	4,400	..	..	..	..	..	..
Perth (W.A.) ..	Feb. 22	2,999	+ 84	8	12,030	— 140	26·45	+ ·32

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Afternoon.

No relief is afforded to the gloomy condition of the Home Railway market. The traffics are going lamentably in the wrong direction in several cases, and the public seems to have taken such fright at the outlook for the companies, that they decline to touch stocks at any price at all. The slump is general, and electrical stocks suffer with the rest. Central London issues are weaker, the Deferred being down to 55½, the Preferred to 93, and the Ordinary to 70. City and South London lost another point at 43, but even this is 1½ higher than the unfortunate Metropolitan Consolidated stock, while Districts are no better than 15. Great Northern and City Preferred fell to 3¼, the guarantee of the contractors being so close to the time of expiry. The announcement that the new Charing Cross, Euston and Hampstead line will be opened about June 1st has not changed the price of the company's 4 per cent. Debenture stock, which remains at 86½.

Traction issues are fairly firm, though without special feature. London United Trams scarcely moved on the report. By reference to the price-list overleaf, it will be noticed that the quotations for the British Columbia Electric Railway stocks have all been narrowed. This has made little difference to the middle prices. Why the same process should not be applied to the whole of the Stock Exchange Official List requires cleverer pens than this to explain. Particularly in the case of electrical securities are the official prices so wide as to be robbed of half of what should be their proper value. Sometimes they were positively misleading.

The Metropolitan Electric Supply final dividend, making 8 per cent. for the year, left the Ordinary shares unchanged at 7½, but the 4½ per cent. Preference fell to their par value of £5. The dividend on the Ordinary is 2 per cent. less than those of the two previous years. Bromptons are ¼ lower, and so are St. James's, County of London Preference, and Kensington Ordinary. While Edmundson's reacted to 2½ after their excessive fall, the Debenture stock relapsed 5 points to 89½, upon the appearance of a seller. For some time past it is probable that the official price was a more or less fictitious one—for sellers, that is.

Chelseas show the heaviest fall amongst the shares, a drop of 10s. taking them to 4½. The fall was connected with the reduction in the dividend.

Should the Progressives be defeated at the polls on Saturday, there might conceivably be a rally in Supply shares, but if to the Liberal Government is linked another Progressive London County Council, the outlook for the share market is not brilliant.

Telegraph descriptions are featureless this week. The Anglo-American gamble proceeds on the same lines as that of last week, but the fall has been nothing like so severe: in fact, it is a slight affair this time. Direct United States Cable shares are ¼ lower, and Cuba Telegraph Preference are ½ down, the latter at 17. In them, of course, the market is exceedingly limited.

National Telephone stocks are firm, and even the Deferred holds its position at 111, despite the somewhat plain hint at the meeting with regard to the prospects when repayment comes into play four years hence. Marconi's are still dull, and there are several selling orders overhanging the market.

Brush Ordinary dropped to 17s. 6d., but Willans Preference rose to 4. Dick, Kerr Ordinary parted with $\frac{1}{16}$, which the Preference shares annexed, the prices now being 1½ and $1\frac{3}{8}$ respectively. Except for these, the manufacturing group is colourless. Reference was made at the British South Africa (Chartered) Company's meeting on Tuesday to the Victoria Falls Power scheme, but the Chairman's optimism failed to arouse the audience to exuberance.

Northallerton Electric Light and Power Co., Ltd.—The directors' annual report shows a net profit of £172. £100 is credited to reserve for depreciation, and £72 1s. 6d. carried forward.

Prospectus.—*Durham Collieries Electric Power Co., Ltd.*—This company has this week made a public issue of £150,000 5 per cent. first mortgage debentures, at 98, for completing the undertaking, paying off existing charges and indebtedness, and providing working capital. The list is to close to-day.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Feb. 19th.	Closing Quotations Feb. 26th.	Business done week ended Feb. 26th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..	Nil
149 600	Do. do. 5 % Debs., Nos. 1 to 1,259 Red.	100	Nil	Nil	5 %	5 %	88 — 91	88 — 91	..	..	..	5 9 11
660,660	Anglo-American Telegraph	Stock	61s.	22½%	31½%	37½%	64 — 66 xd	64 — 64	64	..	..	5 17 5
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	6%	6 %	6 %	109 —110 xd	108½—109½	109⅜	108½	— ½	5 9 7
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	½%	12½%	21⅜— 21⅝xd	21⅛— 21⅜	21⅜	20⅞	— ¼	8 3 9
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	..	101 —103	101 —103	..	..	..	4 17 1
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	..	6⅞— 7⅛	..	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	94¼— 96⅛	94⅛— 96⅛	96½	95½	..	4 2 11
16,000	Cuba Telegraph	10	0 %	5 %	5 %	..	8⅛— 8⅜	8⅛— 8⅜	8⅜	8½	..	5 14 3
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	..	17 — 18	16½ — 17½	..	..	— ½	5 14 3
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	8⅜— 8⅝	8⅜— 8⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	..	9 — 9½	9 — 9½	..	..	..	5 5 3
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
60,710	Direct United States Cable	20	3 %	3½%	4½%	..	15½— 16	15½— 15⅞	15½	15⅜	— ½	5 7 11
60,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	137 —142	137 —142	140½	138	..	4 18 7
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	..	86 — 88	86 — 88	87½	86½	..	3 19 7
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	..	106 —108	106 —108	107½	106	..	3 14 1
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	13½— 14	13⅛— 14	14	13⅞	..	5 0 0
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½—107½	105½—107½	106	105⅜	..	3 14 5
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	99	..	..	3 19 3
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
181,127	Globe Telegraph and Trust	10	5%	5%	5%	..	10½— 11	10⅛— 11	10⅛	10⅛	..	5 0 0
181,127	Do. do. 6 % Pref	10	6 %	6 %	6 %	..	14 — 14½	14 — 14½	14⅜	14⅛	..	4 2 9
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	24 %	24%	..	86½ — 88½	86½ — 88½	..	..	..	6 9 9
33,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	18 %	13 %	..	58 — 60	58 — 60	..	..	..	5 8 4
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	3/16— 7/16	3/16— 7/16	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	..	1 — 1⅛	1 — 1⅛	..	..	..	4 8 11
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	29/32— 1 1/32	29/32— 1 1/32	..	..	..	4 16 5
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	109½—111½	111½	110	+ ½	5 7 7
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5½%	110 —112	110 —112	111½	110	..	4 18 3
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11½ — 18½	11½ — 18½	13	12⅝	..	4 8 11
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10⅝ — 12½	10⅝ — 12½	..	..	..	4 0 0
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	5⅜	..	..	4 5 1
3,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	3½%	97 — 99	97 — 99	97½	..	..	3 10 8
1,689,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101¼	101⅛	..	3 18 5
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6½%	6½%	7½%	..	1 7/16— 1 7/16	1 5/16— 1 7/16	26/3	..	..	5 4 4
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1⅛ — 1½	1⅛ — 1½	..	..	..	4 16 0
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	4 %	4 %	96½ — 98½	96½ — 98½	97½	..	..	4 1 3
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
11,889	Reuter's	8	5 %	5 %	5 %	..	7½ — 8	7½ — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	99 —102	99 —102	..	..	..	4 8 8
8,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	126 —129	126 —129	..	..	..	4 13 0
80,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅜ — 7⅛	6⅜ — 7⅛	6⅞	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 11 11
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	109 —112	..	..	..	4 9 3
15,609	West African Telegraph, Shares	10	4 %	4½%	4 %	..	10 — 10½	10 — 10½	..	..	..	3 16 2
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	3/8— 5/8	3/8— 5/8	..	..	..	Nil
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	..	13⅜— 14½	13⅜— 14½	14	13⅜	..	4 18 3
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —105	102 —105	104	103	..	3 16 2
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	9/16— 11/16	9/16— 11/16	11/10½	..	..	Nil
84,588	Do. do. 6 % Cum. 1st Pref.	10	7 %*	6 %	5 %	..	7 — 7½	7 — 7½	..	..	..	6 13 4
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	5⅜— 6⅝	5⅜— 6⅝	..	..	..	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007		..	8 %	8 %	..	7⅞— 8⅛	7⅞— 8⅛	8⅛	7⅞	..	4 18 6
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5½%	6⅞— 6⅞	6⅞— 6⅞	5⅞	..	..	4 9 10
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	130 —138	135 —138	..	..	..	4 6 11
295,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	104 —107	104 —107	106½	106½	..	4 13 6
580,000	Babcock & Wilcox, 1 to 580,000	1	17 %	20 %	20 %	..	3⅝— 4⅛	3⅝— 4⅛	81/3	..	..	4 14 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..	5 16 7
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	..	5⅜ — 6	5⅜ — 6	5 7/16	..	..	5 16 8
40,000	Do. do. 7 % Cum. Pref...	5	Nil	7 %	7 %	..	6⅛ — 6⅜	6⅛ — 6⅜	..	..	..	5 8 8
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	..	5 — 5⅜	5 — 5⅜	..	..	..	5 4 4
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	..	4 — 4½	4 — 4½	..	..	..	4 8 11
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	101 —105	101 —105	98⅜	..	..	4 15 3
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	98 —101	98 —101	..	..	..	5 8 11
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	..	131 —136	133 —136	134	..	+1½	4 8 3
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	..	114 —118	114 —117	..	..	— ½	4 5 6
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	107 —111	107 —109	107⅞	107½	—1½	4 11 9
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	100 —103	100 —102	..	..	— ½	4 8 3
250,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —104	101½—103½	..	..	..	4 7 0
133,801	British Electric Traction	10	6 %	6 %	3 %	..	3 — 3½	3 — 3⅜	66/10½	61/3	..	8 11 5
161,497	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	7½ — 7⅞ xd	7⅛ — 7⅜	7 6	7 1/10	..	7 16 10
1,148,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	106 —109	106 —109	107½	106½	..	4 11 9
210,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	..	84 — 87	84 — 87	84½	84	..	5 3 6
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	..	6⅝ — 7	6⅝ — 7	..	..	..	5 14 3
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	5⅝ — 6	5⅝ — 6	5⅞	..	..	5 0 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	..	94 — 98	94 — 98	..	..	..	4 11 10
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1½ — 1⅝	1½ — 1⅝	27/6	..	..	Nil
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	67 — 71	67 — 71	68⅜	67½	..	5 12 8
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	11/16— 13/16	11/16— 13/16	..	..	..	Nil
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 16/6	14/6 to 16/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	..	¾ — 1 1/16	¾ — 1	..	..	— 3/32	5 0 0
160,000	Do. Non-cum. 6 % Pref... ..	2	6 %	6 %	6 %	..	1⅝— 2	1⅝— 2	..	..	..	6 0 0
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	95 — 97	95 — 97	..	..	..	4 12 9
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	80 — 83	80 — 83	..	..	..	5 8 5
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	..	4 — 4½	3⅞— 4½	81/3	76/3	— ¼	3 10 7
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	..	5⅛— 5⅜	5⅛— 5⅜	5 7/8	..	..	5 11 8
27,500	Do "B" do. 1 to 27,500	5	6 %	6 %	6 %	..	5 — 5⅛	5 — 5⅛	5⅜	5⅛	..	5 14 3
13,200	Do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	104 —106	104 —106	105⅞	103	..	4 11 4
190,000	Do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
105,000	Calcutta Trams., 1 to 105,000	5	6 %	8 %	8 %	..	8⅛ — 8⅝	8⅛ — 8⅝	..	..	..	4 12 9
82,610	Do. 105,001 to 187,610	5	..	..	8 %	..	7⅞ — 8⅛	7⅞ — 8⅛	7⅞	..	..	4 15 6
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330	5	..	..	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5⅛	..	..	4 6 11
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
35,000	Callender's Cable Construction shares	5	(2½%	2½%	15%	..	9½ — 10½	9½ — 10½	9⅞	..	..	7 3 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅛ — 5⅜	5⅛ — 5⅜	5 1/16	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..	4 3 4
491,222	Cape E. Trams., 1 to 491,222	1	10 %	5 %	Nil	..	7/16— 9/16	7/16— 9/16	10/6	10/3	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	..	1 1/16— 1 1/8	1⅛ — 1⅛	28/3	..	+ 1/16	4 16 0
224,968	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102 xd	98	..	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	73 — 75 xd	69 — 71	73⅛	69	—1	5 12 8
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	94 — 96 xd	92 — 94	94½	..	—2	4 5 1
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	57 — 60 xd	54 — 57	57	54	—3	7 0 4
1,480,000	City and South London Railway	Stock	2¾%	2½%	1⅞%	2½%	43 — 45	42 — 44	44	43	—1	4 16 7
85,000	Crompton & Co., Nos. 1 to 85,000	5	2½%	2½%	2½%	..	2⅛ — 2⅜	2⅛ — 2⅜	46/3	44/4½	..	3 3 6
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to one of £100 and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..	5 2 0

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated, all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Feb. 19th.	Closing Quotations Feb. 26th.	Business done week ended Feb. 26th, 1907. Highest	Lowest.	Rise + or Fall—	Present Yield per cent. £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1 7/8 — 1 15/16	1 7/8 — 1 15/16	..	..	— 1/16	6 8 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 15/16 — 1 31/32	1 15/16 — 1 31/32	..	..	+ 1/32	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½ %	6 %	6 %	..	13 3/32 — 14 3/32 xd	13 3/32 — 14 3/32	..	..	..	4 1 4
59,987	Do. 6% Pref. between 1 and 60,000	10	6 %	6 %	6 %	..	13 3/32 — 14 3/32 xd	13 3/32 — 14 3/32	..	..	..	4 1 4
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	5 3/32 %	4 3/32 %	..	1 1/32 — 1 1/16	1 1/32 — 1 1/16	..	..	..	9 5 0
17,189	Do. "A" shares, 01—017,189	5	Nil	2 1/32 %	4 3/32 %	..	2 1/32 — 2 3/32	2 1/32 — 2 3/32	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..	5 5 3
113,100	Electric Construction 1 to 113,100	2	4 %	Nil	Nil	..	1/32 — 7/32	1/32 — 7/32	..	..	..	Nil
81,390	Do. do. 7 % Cum. Pref., 1 to 81,390	2	7 %	7 %	7 %	..	1 7/32 — 2	1 7/32 — 2	..	..	..	7 0 0
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	81 — 84	81 — 84	..	..	..	4 15 3
95,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	8 7/32 — 9 3/32	8 7/32 — 9 3/32	..	..	..	5 2 4
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	3 %	4 %	4 %	4 %	31 — 33 xd	31 — 33	65/-	..	..	11 18 9
96,000	Greenwood & Batley † % Cum. Pref.	10	7 %	7 %	7 %	7 %	10 1/32 — 10 3/32	10 1/32 — 10 3/32	..	..	— 1/32	6 13 4
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	11 3/32 — 12 3/32	11 3/32 — 12 3/32	12 1/8	12 1/8	..	5 17 8
200,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	5 5/16 — 5 7/16	5 5/16 — 5 7/16	..	..	..	4 0 11
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	107 —109	107 —109	..	..	..	4 2 7
60,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	5 %	10 %	10 %	15 1/32 — 16 1/32	15 1/32 — 16 1/32	15 7/8	..	..	6 3 1
87,500	‡Liverpool Overhead Railway, Ord.	10	1 3/4 %	1 1/4 %	Nil	Nil	1 1/32 — 1 1/16	1 1/32 — 1 1/16	..	..	..	Nil
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6 3/32 — 6 5/32 xd	6 — 7	..	..	+ 1/4	7 2 10
600,070	London United Trams (1901), 1 to 50,007	10	3 %	3 %	3 %	3 %	7 — 8	7 — 8	..	..	..	3 15 6
899,980	Do. do. 50,008 to 100,000 (£8 paid)	10	3 %	3 %	3 %	3 %	5 — 5 1/4	5 — 5 1/4	..	..	..	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7 3/4 — 8 1/4	7 3/4 — 8 1/4	8 1/4	..	..	6 11 3
1,381,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	87 — 90	85 — 90	86	..	—1	4 9 8 11
814,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	..	1/32 — 3/32	1/32 — 3/32	2/-	..	..	Nil
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	1 — 1 1/32	1 — 1 1/32	18/9	18/3	..	5 0 0
350,000	Do. 4½ % Deb. Stock Red.	100	..	4½ %	4½ %	4½ %	96 — 99	96 — 99	..	..	..	4 10 11
30,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	4 3/32 — 4 13/32	4 3/32 — 4 13/32	..	..	..	6 10 8
245,500	Potteries E. Tro.	1	5 %	5 %	4 %	..	6 — 7	1/32 — 3/32	..	..	..	5 6 8
345,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	6 3/32 — 7 3/32 xd	6 — 7 1/32 xd	..	..	..	7 5 5
345,000	Do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	..	98 3/4 —101 1/4	98 3/4 —101 1/4	..	..	..	4 8 8
87,850	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	32 — 34	32 — 34	32 1/2	..	..	5 4 4
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1908	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	83 — 85	83 — 85	..	..	..	5 17 8
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1 1/32 — 2	1 1/32 — 2	36/-	..	..	Nil
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3 1/32 — 4	3 1/32 — 4 1/4	..	..	+ 1/4	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	77 — 82	77 — 82	..	..	..	4 17 7

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5 %	5 1/32 %	5 1/32 %	..	5 — 5 1/8	5 — 5 1/8	..	..	..	5 0 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½ %	4½ %	4½ %	4½ %	99 —101	99 —101	..	..	..	4 9 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	..	8 — 9	7 3/32 — 8 3/32	..	..	— 1/32	5 14 3
10,502	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	7 1/8 — 8	7 1/8 — 8	7 1/8	..	..	4 7 6
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
60,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3 1/32 — 4 1/32	3 1/32 — 4 1/32	77/6	..	..	5 17 8
60,000	Do. do. 4½ % Cum. Pref.	5	4½ %	4½ %	4½ %	4½ %	3 1/32 — 4 3/32 xd	3 1/32 — 4 3/32 xd	..	..	..	5 2 10
90,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½ %	4½ %	4½ %	4½ %	3 1/32 — 4	3 1/32 — 4	..	..	..	5 12 6
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	99	..	..	4 0 0
49,486	Chelsea Electricity Supply, Ord.	5	5½ %	6 %	6 %	4½ %	4 3/32 — 5 1/32	4 — 5	93/9	90/-	— 1/32	4 10 0
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	4½ %	104 —107	104 —107	106½	106	..	4 4 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9 1/32 — 10 1/32	9 1/32 — 10 3/32	10 7/16	10	+ 1/32	5 11 7
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 1/32 — 12 1/32	11 1/32 — 12 1/32	11 1/4	11 1/4	..	4 16 0
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —124	121 —124	122 1/2	..	..	4 0 8
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½ %	4½ %	4½ %	4½ %	98 —101	98 —101	..	..	..	4 9 1
40,000	County of Durham Electrical Power, Ord.	4	4 %	£3 7 0	4 %	..	3 1/16 — 4 1/16	3 1/16 — 4 1/16	..	..	..	3 16 2
60,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	..	4 3/32 — 5 1/32	4 3/32 — 5 1/32	..	..	..	4 15 3
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½ %	5 %	5 %	8 1/32 — 9 1/32	8 — 9	..	..	— 1/32	5 11 1
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	10 1/32 — 11 1/32	10 1/32 — 11 1/32	11 1/32	..	..	5 4 4
400,000‡	Do. do. 4½ % Deb. Stock	..	4½ %	4½ %	4½ %	4½ %	105 —108	105 —108	105	..	..	4 3 4
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	98 —101	97 —100	98 1/2	..	— 1	4 10 0
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	..	2 1/32 — 2 3/32	2 1/32 — 2 3/32	52/6	..	..	8 8 5
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	4 — 4 1/4	4 — 4 1/4	90/-	..	..	6 13 4
350,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½ %	4½ %	4½ %	4½ %	93 — 96	88 — 91	..	..	—5	4 18 11
10,000	Folkestone, 1 to 10,000	5	5 1/16 %	5 1/16 %	5 1/16 %	..	5 1/16 — 5 3/32	5 1/16 — 5 3/32	..	..	..	4 17 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	..	5 — 5 1/4	5 — 5 1/4	..	..	..	4 15 3
90,000	Do. 4½ % 1st. Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	97 —100	97 —100	..	..	..	4 10 0
18,000	Hove, 1 to 18,000	5	8½ %	8½ %	9 %	..	7 1/32 — 8	7 1/32 — 8	..	..	..	5 12 6
21,000	Kensington and Knightsbridge Electric Ord.	5	12½ %	12 %	10 %	10 %	9 1/32 — 10 1/32	9 — 10	..	..	— 1/32	5 0 0
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	97 —100	97 —100	100 1/2	..	..	4 0 0
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	2 — 2 1/32	2 — 2 1/32	..	..	..	4 17 0
70,000	Do. do. do. 6 % Pref...	5	6 %	6 %	6 %	6 %	4 3/32 — 5 1/32	4 3/32 — 5 1/32	5 3/16	..	..	3 14 3
874,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 11 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8½ %	10 %	10 %	8 %	7 — 8	7 — 8	7 1/4	7 5/16	..	5 0 0
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½ %	4½ %	4½ %	4½ %	5 1/32 — 5 1/16	4 1/32 — 5 1/32	5 1/16	5 3/32	— 1/32	4 3 9
200,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½ %	4½ %	4½ %	4½ %	106 —110	106 —110	..	..	..	4 1 10
350,000‡	Do. 3½ % Mort. Deben. Stock Redeem.	Stock	3½ %	3½ %	3½ %	3½ %	91 — 94	91 — 94	..	..	..	3 13 10
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½ %	4½ %	4½ %	4½ %	96 — 99	96 — 99	96 1/2	..	..	4 10 11
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	..	7 3/4 — 8	7 1/2 — 8	..	..	— 1/16	5 0 0
75,000	Do. 5 % Pref., 1 to 75,000	5	5%	5 %	5 %	..	5 3/32 — 6 1/32	5 1/32 — 6	..	..	— 1/4	4 3 4
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7 %	7 %	12 1/32 — 13 1/32	12 1/32 — 13 1/32	13 1/8	13	..	5 11 1
64,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½ %	7 %	7 %	7 %	6 — 6 1/4	6 — 6 1/4	..	..	..	5 7 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..	4 1 8
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½ %	14½ %	12½ %	10 %	8 1/32 — 9 1/32 xd	8 — 9 xd	8 3/8	8 3/16	..	5 11 1
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	6 3/32 — 7 3/32 xd	6 3/32 — 7 3/32 xd	..	..	..	4 10 4
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½ %	3½ %	3½ %	3½ %	93 — 95	93 — 95	..	..	..	3 13 8
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	1 — 2	1 — 2	31/3	30/-	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75	71 — 75	71	70 1/2	..	5 6 8
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2 1/32 — 3	2 1/32 — 3	..	..	..	6 13 4
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½ %	2½ %	3/32 — 3/32	3/32 — 3/32	12/6	..	..	3 6 8
117,968	Do. Do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 1/32 — 1 1/16	1 1/32 — 1 1/16	25/-	..	..	5 1 10
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½ %	4½ %	4½ %	4½ %	102 —105	102 —105	..	..	..	4 5 9
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	2 3/32 — 3 3/32	2 1/32 — 3 3/32	55/-	52/6	..	6 13 4
60,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	3 1/32 — 4 1/32	3 1/32 — 4 1/32	85/-	..	..	5 17 8
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	4½ %	4½ %	..	99 —102	99 —102	100 1/2	99 3/4	..	4 8 3
110,000	Westminster Electric Supply, Ord.	5	13½ %	14 %	13 %	12 %	9 1/32 — 10 1/32	9 1/32 — 10 1/32	9 15/16	9 3/16	..	5 17 1
81,279	Do do. 4½ % Cum. Pref. (Originally 5%—Red. to 4½ % from 31st Dec., 1905.	5	5 %	5 %	5 %	4½ %	5 1/8 — 5 3/8	5 — 5 1/4	5 1/16	5 1/8	— 1/8	4 1 10

Shares not officially quoted:—Mackay Companies, ord., 74—76 — 2. Pref. 71—73 — 1.
† Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

Bank rate of discount 5 per cent. January 17th, 1907.

IMPROVEMENTS IN PROJECTORS.

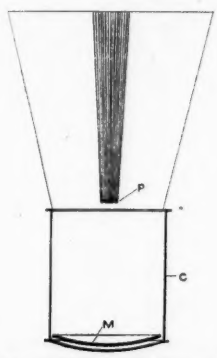
By JOHN I. HALL.

I.

This article deals with the utilisation of ordinary dispersion lenses of projectors to fulfil the requirements of the Suez Canal regulations. Those regulations stipulate that all ships traversing the Canal at night by means of search lights, shall project a beam of light forward which shall have a shadow in the centre of 5° divergence. Thus, in reality, the projector sends out two beams of light, one to the right and one to the left, which light up the sides of the channel, showing clearly the position of the buoys on each side, while the passage directly ahead of the ship is not illuminated.

The object of the dark centre in the beam is to assist in safe navigation. It was found that a full beam of light affected the sight of the navigating officers of two ships approaching each other, so greatly, that they could not distinguish each other's signal lights, or the buoys of the channel, and serious risks were run of collision and grounding.

As it was at that time difficult to see how an ordinary dispersion lens could be used for this purpose, the Hon. C. A. Parsons invented a mirror which gave the necessary divergence of light, and to obtain the shadow a metal plate, P, was put down the front of the projector, as shown in fig. 1.

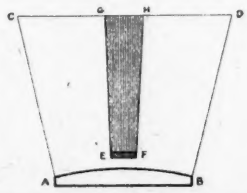


C, Projector case; M, Dispersion mirror; P, Metal plate.

Fig. 1.

As far as the writer is aware, the ordinary dispersion lens has not been used practically by ships navigating the Suez Canal, although there is no reason why such lenses should not be so used. A little consideration will show that dispersion lenses will serve the purpose admirably.

It is only necessary to consider fig. 2, which shows one section of a dispersion lens. These sections are 2½ in. broad, and in a 20-in. dispersion lens there are thus eight sections. It is quite plain that, if an opaque object is put down the centre of one section, as shown in fig. 2, a shadow will be cast forward, and the beam will be divided into two parts.



A B, One section of dispersion lens; E F, Opaque object; A B C D, Projected beam of light; E F G H, Shadow in centre of beam.

Fig. 2.

If two adjacent sections of the mirror are treated in the same manner, it is evident that the shadows will at some point, O, intersect each other, and beyond that point there will be only one dark opening in the combined beam emanating from the two sections.

This is shown clearly in fig. 3, where the lights and shadows from two sections are projected forward.

By reference to fig. 3 it is obvious that beyond the point of intersection O of the lines F H and E′ G the beam will be divided into two parts, formed respectively by the lines B D F H and E′ G A C. The diverging shadows F′ E′ X′ and F E X are, of course, dispersed beyond the points X′ and X by the light projected from the outer portions of the lenses, and beyond the points X and X′ the two parts of the beam are clear and distinct.

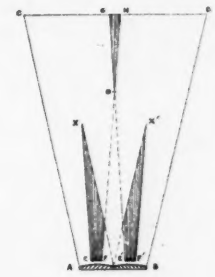


Fig. 3.

To illustrate the object further, fig. 4 shows three adjacent sections of a dispersion lens, which will give a clearer idea of the dispersion of the incidental shadows, and the formation of the ultimate shadow in the beam.

The incidental shadows are shown terminating at X, X′, X″, the ultimate shadow beginning at O by the intersection of the shadows E″ G and F H produced by lenses 1 and 3.

The shadow of the intermediate section is cut off, as shown.

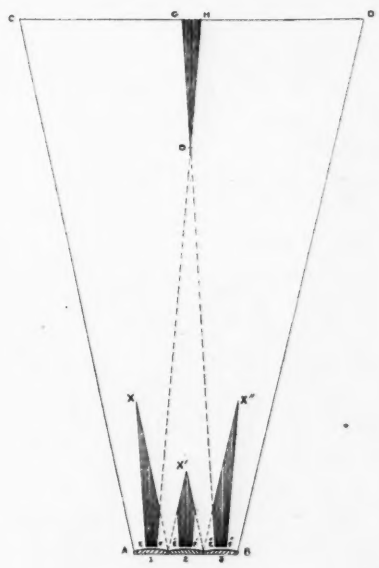


Fig. 4.

Dispersion lenses, however, consist of more than three sections, the usual number being 8 for a 20-in., and 10 for a 24-in. dispersion lens.

This method of obtaining the shadow has been tried experimentally with a 20-in. dispersion lens, and a plan of the complete beam is given in fig. 5, p. 368.

The foregoing illustrations have been drawn solely to illustrate the principles involved in this subject. Fig. 5 shows the assemblage of a 20-in. dispersion lens formed of eight sections.

It may not be quite clear, at first view, how the shadows of sections 2 to 7 can form any part of the ultimate shadow, as they are apparently dispersed where shown in fig. 5 by the light from the adjacent lenses. But by following the shadows, shown by dotted lines, cast by sections 2 and 7 it will be observed that parts of all the shadows pass through the point O and contribute their share to the ultimate shadow O G H.

Fig. 5 is not drawn to scale, as it is necessary to contract it for illustration purposes. The divergence given in the figure is 16°, whereas the correct angle is only 5°. The efficiency of a dispersion lens for illuminating purposes is in no way impaired when used in this manner for lighting the buoys of the channel.

The base of the shadow in such a beam of light is formed by the shadows produced by the respective lenses 1 to 8 in fig. 5, and in a 20-in. projector would be about 18 in. across. This measure being the base of a cone having a

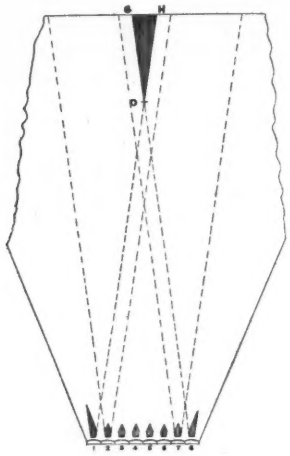


Fig. 5.

divergence of 5°, it is obvious that the point o, being the apex of the cone, will be approximately 15 ft. from the face of the projector.

At the point o, the ultimate shadow of the projector begins, and from this point the beam is divided into two parts, thus fulfilling the requirements of the Suez Canal regulations; such projectors are also useful for ships navigating harbours and channels when approaching or leaving port.

The shadow strips can be made in a separate grid-frame, and secured to the rim of the dispersion lens, or made in separate and independent sections. For lightness they can be made of angle or T pieces, as shown in figs. 6 and 7.

Fig. 6.

Fig. 7.

Fig. 8 shows a channel with buoys on either side, and two ships navigating it in opposite directions. By reference to this figure, each of the ships is seen to be in the shadow cast by the projector of the other ship, the buoys of the channel on either side being illuminated.

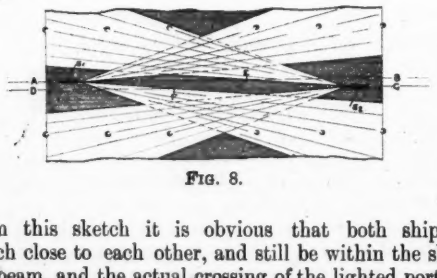


Fig. 8.

From this sketch it is obvious that both ships can approach close to each other, and still be within the shadow of the beam, and the actual crossing of the lighted portion of the beam only occupies a short time.

It is a little curious to observe how the lights and shadows cross each other, and how the former disperse the latter in the intervening space between the two ships, the ultimate shadows appearing again in which the ships are enveloped.

Referring again to fig. 8, S_1 indicates a vessel on the course indicated by the line A B, and S_2 a ship on the course C D.

As the ships get nearer to each other, they approach the points E and F, and enter the illuminated zones. In passing through, the light impairs the observation of the navigating officers, but to prevent this the writer has devised an adjustable shutter, as shown in fig. 9.

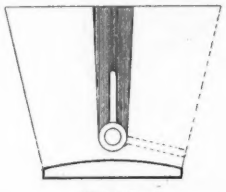


Fig. 9.

When the ships arrive at the points E and F, the operators of the projectors, at a given signal, turn the shutters round to the position shown by dotted lines, and the light is shut off altogether on the starboard side of each vessel, until they have passed each other.

These shutters can also be made with flaps, so that the light may be cut off altogether should it be necessary.

WIRELESS TELEPHONY.

By R. A. FESSENDEN.

(*Concluded from page* 329.)

Still another arrangement which may be mentioned is the so-called "condenser dynamo," consisting of a pair of slotted disks revolving opposite each other with an insulating diaphragm between them, and with a special arrangement for obviating the effects of loss of efficiency due to the spreading of static charge over the insulating diaphragm. Frequencies up to 200,000 per second are readily obtained with this device, and it is not certain but that this may supersede the high-frequency dynamo. The output of a machine of this kind is incredible, unless one actually figures it out.

Yet another device of the writer's is a method of using two discharge gaps and causing the magnetism of the local circuits to force the discharge from one gap to the other alternately.

A similar device has been used by the writer in connection with his development of the Elihu Thomson singing arc for wireless purposes, for regulating the frequency. In this arrangement, for which patents were filed some years ago, a multiple spark gap is used, and a tuned circuit connected across the two metal gaps and linked loosely to the primary. By the use of this device the centre spark gaps are broken down by the freely oscillating circuit, and hence the device acts as a governor to the main discharge.

It will be unnecessary and, indeed, impossible to go into the many hundred schemes for carrying out this work, which the writer has devised during the past five or six years. In due time most of them will be issued as patents. The fact may here be mentioned as of interest, that the writer has obtained promising results with a method using a number of dry cells and without employing a discharge gap or moving parts of any kind.

Means for Modifying the Character of the Emitted Impulses.—Fig. 8 taken from United States Patent 706,747 (July 22nd, 1902), and fig. 6 from United States Patent 706,742 (June 6th, 1902), show some earlier types of transmitting devices. In the first type shown in the left-hand diagram of fig. 8 advantage is taken of the fact that if the resistance of a transformer secondary be changed it alters the inductance of the primary.

In the middle diagram of fig. 8 is shown what I call the "condenser transmitter." In this arrangement the approach and recession of a conducting diaphragm to and from a fixed plate alter the degree of resonance in the aerial.

As a practical illustration, with a diaphragm 2 centimetres in diameter, a movement of $\frac{1}{100}$th of an inch inwards with the arrangement used for telephoning to Plymouth reduced the current from 3·1 amperes to 2·5 amperes. This is without a resonant circuit between the movable terminals of the condenser transmitter and ground. With this and other modifications, which I cannot publish at present, much greater effects are obtained.

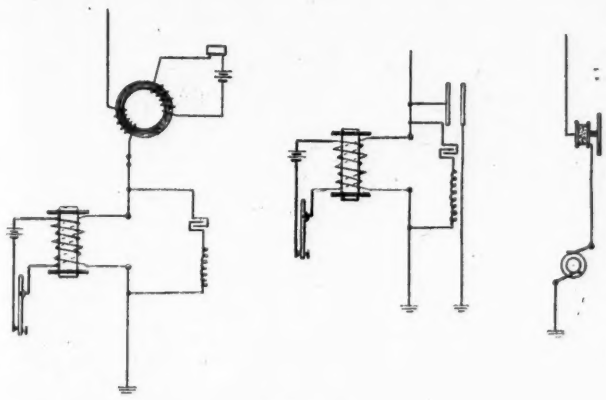


Fig. 8.

The right-hand diagram of fig. 8 shows a one-carbon transmitter in series with the aerial. While the condenser transmitter is probably the best method of all, the carbon microphone method works very well. To get the best results the ohmic resistance of the carbon transmitter should be equal to the radiation resistance of the aerial.

In practice the carbon microphone transmitter is generally placed between the exciting circuit and ground, as shown in fig. 7 for the purpose of preventing possible shocks.

A carbon transmitter may also be placed in the field of the high-frequency alternator as shown in United States Patent 793,649, March 30th, 1905. This is rendered possible by the small amount of iron in the field, but it works better when the armature circuit is wound differentially and a differential transmitter is used.

Another method is to use the armature winding differentially, with a second field, to shift the position of the field. This also works well.

A very simple sending arrangement is shown in fig. 9 (United States Patent 793,649, March 30th, 1905), which, however, is not very good on account of the scratching.

Many other arrangements might be mentioned, but the above will be sufficient.

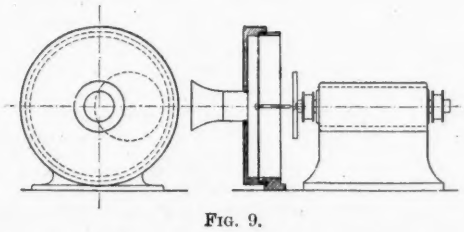


Fig. 9.

Apparatus for Receiving.—At the time the writer took up the subject of wireless telegraphy the only receivers used were the imperfect contact type. These were not considered satisfactory. A receiver, for example, which is not constantly active cannot give the best results. Moreover, these devices were all voltage-operated devices, and it was apparent to the writer that a current-operated receiver was what was needed.

Various forms of current-operated receivers were, therefore, invented, and a broad patent was issued to the writer covering all forms of current-operated receivers (United States Patent 706,736, December 15th, 1899).

These number altogether more than 100 different forms. Amongst these may be mentioned the modification of Elihu Thomson's galvanometer (United States Patent 363,185, May 17th, 1887) consisting of two coils at an angle to each other, which appears to have been subsequently independently invented by Prof. Fleming; by suitably altering its construction, and by devising a shunt resonant circuit, previous to which time series resonant circuits had been exclusively used for wireless work, Elihu Thomson's device was rendered suitable for wireless work. Amongst other forms of receiver may be mentioned the hot-wire barretter, the liquid barretter, the eddy-current receiver, the beats method, the microbaric receiver, the repulsion disk, &c.

In practical telephone work, however, the liquid barretter has been most generally used, this giving quite good results.

The receiver *par excellence* is, however, the writer's heterodyne receiver, one modification of which is illustrated in fig. 10. As this has now been a number of years in the Patent Office, a brief description may be given, as follows:—

All forms of voltage-operated receivers, and most forms of current-operated receivers, with the exception of two or three of the writer's inventions, are very inefficient. Even the liquid barretter, which is as sensitive as any of those in common use, has an efficiency of only about one-tenth of 1 per cent. for weak signals. This might, of course, be expected from the fact that the liquid barretter forms a thermo-dynamic engine.

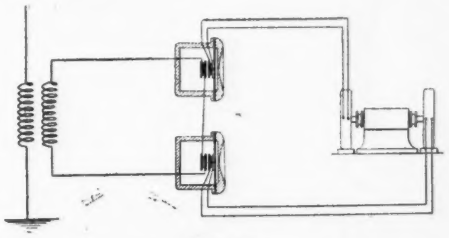


Fig. 10.

In the writer's experiments the magnetic receiver is rather less efficient; in any case, the efficiency, or rather inefficiency, is of the same order of magnitude.

A liquid barretter or magnetic receiver will give an audible indication between $\frac{1}{100}$th and $\frac{1}{1000}$th of an erg. An ordinary telephone receiver requires to produce an indication less than a millionth of an erg.

It is evident that if any method could be devised for using a telephone receiver direct the efficiency would be increased about a thousand times.

This the writer has succeeded in doing with his heterodyne receiver. This is a combination of the "beats" method of United States Patent 706,740 (September 29th, 1901), and the method of operating by continuously generated waves of United States Patent 706,737 (May 29th, 1901).

A telephone is constructed having a fixed magnetic core formed of iron wires $\frac{1}{1000}$th of an inch thick, and excited from a source of high frequency such as a high-frequency or condenser dynamo.

A small coil with or without a core is cemented to a thin mica diaphragm, and this coil is arranged to be excited by the oscillations produced by the received magnetic waves.

It is, of course, impossible to make the frequency of the waves generated at the sending station exactly equal to the high-frequency oscillations generated at the receiving station. In fact, this is not desirable for most work. Advantage is, however, taken of the fact that if the frequencies are slightly different, beats will be produced and the telephone will emit a musical note.

This is, undoubtedly, the most efficient form of receiver in existence, and it is doubtful if the method will be improved upon so far as most classes of work are concerned.

No difficulty is found in practice in maintaining the frequency of wave generators, or "wave mills" as they are called, to within one-quarter of one per cent. by automatic means.

One advantage of the heterodyne receiver is that it is obviously unaffected by atmospheric disturbances or by disturbances from near-by stations, and that it lends itself very nicely to multiplex working, it being unnecessary to point out that there is no difficulty with this receiver in receiving a message on the same aerial which is being used

to transmit a message to another station. This places for the first time wireless telegraphy on an absolutely reliable and commercial basis, and renders it capable of entering into competition with both landlines and cables.

With the heterodyne system, practically any number of messages can be simultaneously transmitted and received on the same aerial without interference from each other or from neighbouring stations.

Many interesting arrangements and effects could be described, but this note is already much longer than I had originally planned. Many references have been made to patents. This has been done for the purpose of indicating where more complete descriptions of the various devices described may be found.

Another very interesting question is the relative efficiency of the mechanically-generated waves and waves generated by spark-gap. Some writers, Dr. Fleming, for example, in "The Principles of Electric Wave Telegraphy," hold that electro-magnetic waves cannot be generated mechanically. This, however, is not correct, as I have

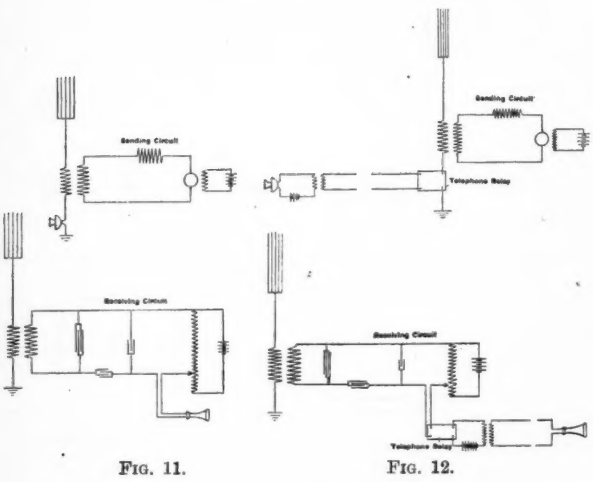


Fig. 11. Fig. 12.

demonstrated practically that waves can be generated in this way more efficiently than in any other way. Dr. Louis Austin, to whom I was glad to afford the necessary facilities, has investigated the matter, and has a paper in preparation covering this point.

I had intended giving a description of various forms of relays which have been used for amplifying the speech and for transmitting over wire lines, but this must be left for a future occasion.

Figs. 11 and 12 show the general arrangement of circuits for operating between Brant Rock and Plymouth, fig. 11 showing the method of operating without a relay and fig. 12 with a relay.

At a recent demonstration which was attended by some prominent telephone experts, the transmission of music, phonograph talking and speech was pronounced to be as good as over a regular 30-mile cable, and to be extremely clear and distinct.

PROCEEDINGS OF INSTITUTIONS.

Comparative Life Tests on Carbon, Nernst, and Tantalum Incandescent Lamps Using Alternating Currents.

By H. F. Haworth, Ph.D., M.Sc., B. Eng.; T. H. Matthewman, B. Eng.; and D. H. Ogley, B. Eng.

(*Abstract of Paper read before the* Institution of Electrical Engineers *in London, February 7th*, 1907.)

The greatest difficulty in making life tests on lamps is to keep the applied voltage constant, since if this is not done the value of the tests is comparatively slight, unless the actual pressure variations are recorded. The apparatus specially designed and made for these tests in order to keep the voltage automatically constant, consists first of a dynamometer, the fixed coils of which have a laminated iron core. Above the moving coil and fixed rigidly to it is a light, rigid rectangular aluminium frame (see fig. 1). Across the middle of this rectangle a phosphor-bronze strip G F is stretched horizontally by means of the spring F, and on the centre of this strip a light aluminium tube B K E is fixed, B K being 3 in. long and K E 6 in. The coil is suspended at the top and bottom by phosphor-bronze strips. The bottom strip is attached to the dynamometer base by a spring, and the top one to a bracket which carries a torsion head. This coil is controlled by a light steel spring fixed at one end to the aluminium rectangle and at the other to the

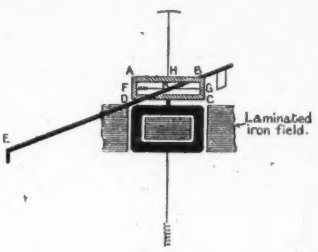


Fig. 1.

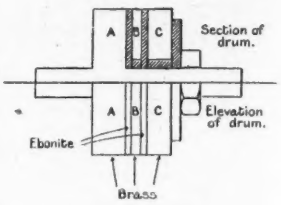


Fig. 2.

torsion head, which is of the Siemens pattern. The bronze strip F G acts as a pivot for the pointer B E, and enables it to move up and down as it is deflected across the surface of the revolving drum (described below); the end of the pointer thus makes good electrical contact in all positions, the contact pressure being constant and depending on the position of the balance weights attached to the short end of the pointer.

The end E of this pointer B E moves over the surface of a revolving drum, the arrangement being similar to that used by Mr. S. G. Brown in his drum cable relay. This drum (fig. 2) has two wide sections A and C and one narrow section B.

Contact is made to the A section through the bearings, B is insulated from A and C, and has no contacts; C is also insulated, contact being made through a springy copper brush.

Wires from the contacts to the outer sections of this drum run to a double relay, the armature of which is fitted up as a reversing switch, contact being made through mercury cups.

The contact piece E of the aluminium dynamometer pointer is made of black lead taken from a pencil. This does not pit the drum when it sparks like a platinum contact does (N.B.—The drum is made of brass) and it is much lighter.

Contact between the drum and pointer is facilitated by shunting condensers across the revolving contacts (as in Mr. Brown's drum cable relay just referred to).

The relay armature primarily controls the direction of rotation of a small series-wound electric motor by reversing the armature current. This motor drives, by means of worm gearing, an iron wire resistance, calculated to give a no-load voltage variation on the machine of about 8 volts either way.

The alternator P.D. is regulated by hand till the required value, 230 volts, is reached. The torsion head of the dynamometer is then turned until the dynamometer pointer contact swings on to the centre neutral section of the drum, and it is then switched on to the relay and motor resistance circuits. If the voltage of the alternator from any cause rises, the dynamometer pointer swings on to a live section of the revolving drum, thus closing the relay circuit on one side, bringing the relay armature down on that side and closing, through mercury cups, the circuit of the motor driving the field resistance of the alternator. This motor is set so as to revolve in such a direction that the field resistance is increased, thus diminishing the alternator field current and reducing the voltage.

When the voltage is again normal, the dynamometer pointer moves back to the neutral section of the revolving drum, thus breaking the relay circuit, which in turn breaks the motor circuit controlling the field resistance. When the voltage falls, the reverse of this series of operations takes place.

This method, of course, applies equally well for continuous as for alternating currents; the difficulty in constructing a voltage regulator for alternating current work usually being the rather weak dynamometer force available.

To obtain the varying voltage of Part II a rotary resistance was made which could be gradually introduced and taken out of the main circuit, so that the voltage across the lamps fell from 240 to 230, and then rose to 240 volts again.

A comparison of the average results of tests of carbon and Nernst lamps in Part I shows a saving of 57 per cent. in watts per candle in favour of the Nernst lamp. The percentage cost saving is much less than the percentage energy saving, on account of the frequent and expensive renewal of glowers and iron resistances.

Against the saving in cost we must place—The much higher capital outlay on the lamp; the large sizes in which it is manufactured; the time it takes to light; the erratic life of the glowers.

It must be remembered that these tests are made with alternating currents, and that the Nernst lamp appears to work much better with continuous current.

In Part II the tests were divided into three series:—

1. Lamps run on their constant normal voltage (230). Duration of test, 1,000 hours.

2. Lamps run on a constant voltage (240), about 5 per cent. above normal. Duration of test, 750 hours.

3. Lamps run on a voltage varying continually between 230 and 240 volts, the variation having a period of two minutes.

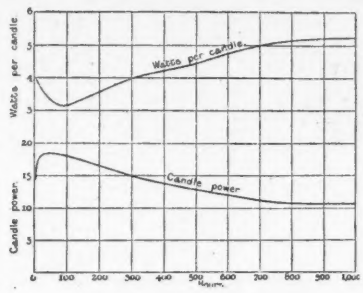
Some of the results obtained are represented graphically by the curves in the accompanying diagrams.

In the first series of tests six lamps, three 16-c.p. and three 32-c.p., of each kind were tested, except tantalum lamps, in which case two 115-volt lamps were placed in series. The Nernst lamps used were 245 volts, 0·25 ampere, marked 225 volts on the filament and 20 on the ballasting resistance, and it was found that they gave better results on the 240 than on the 230-volt circuit, yet they were the lamps sold for use on the 230-volt mains at Liverpool.

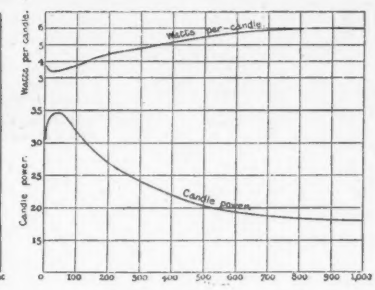
that the faster the resistance of the glower increases the shorter is its life.

Referring to the tests on carbon lamps, the "4 watts per c.p.-lamp" is generally the exception on alternating-current lamps. The cost of an incandescent lamp is an extremely small item in the cost of lighting compared with the expenditure for energy, and should not be considered in buying a lamp.

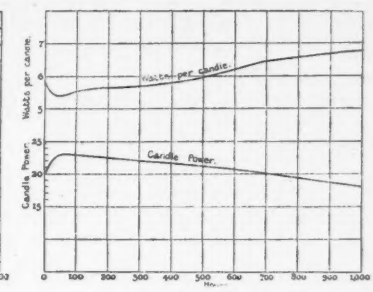
In the majority of cases when used with alternating currents incandescent lamps do not give their proper candle-power, and usually no two lamps made and calibrated by the same maker will agree. With some makers the small-size lamps are good and the



No. 13A; Nominal 16 c.p.

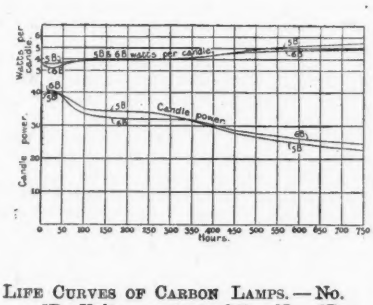


No. 34A; Nominal 32 c.p.

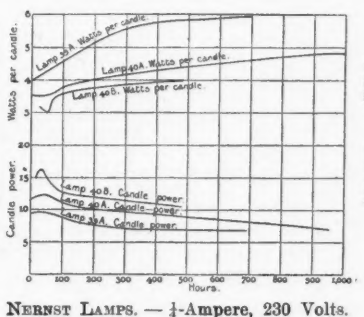


No. 44A; Nominal 32 c.p.

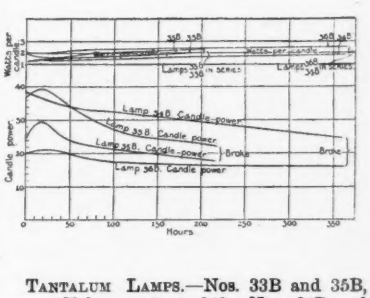
Life Curves of Carbon Lamps. Volts Constant, 230.



Life Curves of Carbon Lamps.—No. 5B, Volts constant, 240; No. 6B, Volts varying, 230—240.



Nernst Lamps.—¼-Ampere, 230 Volts. Nos. 39A and 40A, opal globes; No. 40B, clear globe.



Tantalum Lamps.—Nos. 33B and 35B, Volts constant, 240; Nos. 34B and 36B, Volts varying, 230—240.

In the second and third series of tests two lamps, one 16-c.p. and one 32-c.p., of each make were employed.

In all cases the frequency of supply was 50.

Carbon Incandescent Lamps.

No. lamp and curve.	Hours run.	Volts applied.	Reputed c.p.	Average c.p. for total run.	1st 250 hours. c.p.	1st 250 hours. w.p.c.	Average watts per candle.
13A	1,000	230	16	13·1	17·00	3·28	4·36
34A	1,000	230	32	22·3	29·60	3·94	5·14
44A	1,000	230	32	21·0	22·5	5·55	6·00
5B	750	240	32	29·8	35·00	3·80	4·42
6B	750	240-230	32	30·0	34·00	3·80	4·32
13B	750	240	32	24·6	32·10	3·90	5·20
14B	750	240-230	32	25·0	28·00	4·25	4·80

Tantalum Lamps.

37A	400	230	25	21·1	20·3	1·97	2·08
38A	400	230	25	19·1	19·3	2·11	2·18
33B	235	125	25	27·9	27·9	1·61	1·61
35B	235	115	25	21·2	21·1	2·00	2·00
34B	368	128	25	30·0	30·0	1·60	1·60
36B	368	112	25	17·0	17·0	2·35	2·35

Nernst ¼-ampere Lamps.

			Globe.				
39A	690	230	opal	7·3	8·32	4·70	5·38
40A	960	230	opal	8·9	10·85	3·77	4·30
40B	480	230	clear	11·9	12 73	3·55	3·73
23A	250	230	clear	8·8	8 85	4·70	4·55
23A	740	230	clear	9·4	10·10	3·90	4·11
29B	750	240	opal	12·0	16 20	3·24	4·12
30B	560	240-230	opal	12·5	15·15	3·40	3·84

In Part I the voltage across the glowers was also measured. The glower voltage always increases with time.

This increase is due to alteration in the glower itself and to deterioration of its metallic contacts, and it is interesting to note

large ones very bad. In all cases there was a rise in candle-power after the beginning of the run.

Breakages generally took place when, after a long run, the lamps were switched off on Saturday for the week-end. This would seem to be due to the contraction during cooling, the filament breaking when it had become weakened by long burning.

Curve 13 A is typical of a carbon lamp run at normal voltage. 34 A is characteristic of a class of lamps which start very well and finish badly. 44 A is a typical 32-c.p. lamp, starting about 23 c.p. and depreciating very slowly. 39 A, 40 A, and 40 B are Nernst lamp curves. 5 B and 6 B are typical curves of two similar carbon lamps, one over-run at 240 volts and the other on pressures varying from 230 normal to 240 volts. 33 B and 35 B are tantalum lamps over-run at 240 volts; 34 B and 36 B are tantalum lamps on voltages varying between 240 and 230.

The average of "the average watts per candle" for the 70 carbon lamps tested is 4·86; for the eight ¼-ampere Nernst lamps tested this average is 4·14, and for the six tantalum lamps 1·97.

The ordinary ¼-ampere Nernst lamp of commerce is thus about 15 per cent. better than the average carbon lamp, while its life is about 560 hours.

The average consumption of the tantalum lamps tested was 60 per cent. less than that of the carbon lamps, and their lives were on an average 330 hours; doubtless the tantalum lamps now made will give much longer lives than these.

This research was carried out at the University, Liverpool thanks are tendered to Prof. Marchant for his encouragement and valuable help.

Discussion.

Prof. Ayrton asked what was the sensibility of the automatic regulator described by the authors, and was informed that it was ± ½ per cent.

Mr. C. C. Paterson asked how the candle-power of the Nernst lamps was determined; comparisons were difficult to make on account of the different light directions of different lamps. He considered the varying voltage tests very interesting.

Mr. J. T. Morris, referring to the tantalum lamp tests, said it was possible that the shortening of life was due to change in length of filament with alternating cycles—the candle-power fluctuated, and contraction and expansion occurred.

Mr. A. Campbell asked whether the author was quite sure that the shiver in the tantalum filament when running was not due to high-frequency oscillations in the circuit.

Mr. C. P. Sparks pointed out that the price of incandescent lamps had gone down as well as their efficiency during the past few years; a better lamp could be produced at a higher price.

Mr. L. Gaster thought the second paper confirmed the poor showing of present-day lamps, notwithstanding remarks to the contrary. He considered that the official testing of circuits would lead to considerable improvement in pressure fluctuations.

Prof. E. W. Marchant remarked that he had as a result of many tests between the pentane lamp and the Ediswan large bulb standard lamp found a variation of c.p. of 19·2 to 19·7, which result might be due to the large photometer room in which the tests were made. The regulator described by the authors was an excellent instrument, and was applicable to large lamp installations where it would save many lamps. The Liverpool pressure varied from 220 to 245 volts, and was nominally 230; if the lamps supplied in Liverpool were not up to their nominal pressure it would explain the bad results obtained by the authors.

Mr. Haworth, in briefly replying, said that the lamps run at 230 and 240 volts were supposed to be by the same maker, and the circuits were used exclusively for lamp tests.

Magnetic Oscillations in Alternators and their Bearing upon the Design.

By G. W. Worrall, M.Sc., M.Eng.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Manchester, February 5th*, 1907.)

Continuing a series of investigations of the periodic variations in the magnetic field of a three-phase generator, the author experimented upon two armatures similar in every respect, except that the slots of one were open, and of the other closed, the size of wire in the latter case being slightly smaller than in the former on account of the reduced space available. Search coils were used, in conjunction with the Duddell oscillograph. It was found that while the movement of flux at the centre of the pole face, expressed as a percentage of the total flux entering a tooth on open circuit, varied from 40 to 56 according to the conditions of loading with open slots, it was only from 1·3 to 3·3 with closed slots. The maximum observed was in the former case 66 per cent., under the trailing pole-tip at half load inductive, and in the latter case it was 6·2 per cent., also under the trailing tip, but at full inductive load. Oscillations were also observed in the inter-polar space, due to the armature teeth.

Besides the oscillations mentioned above, oscillations superposed on these were observed in all the search coils. These were partly due apparently to irregularity of construction or to the reaction of the flux produced by a local current in the armature. Other oscillations, of three times the normal frequency, were traced to the armature reaction, and indicate that the reaction of a three-phase armature is not constant in magnitude, but varies with the positions of the respective phase-windings with regard to the pole-pieces. Oscillations of twice the normal frequency were found to be caused by the loads on the respective phases being out of balance.

In all cases oscillations were observed in the flux in the main magnetic circuit—least in the yoke, greater in the limb, and by far the greatest in the pole shoes. The yoke was solid, while the limb and pole shoes were laminated. These oscillations were constant under all conditions of loading, and with both open and closed slots. The width of the pole-face was equal to 5½ times the tooth pitch, so that during the movement of the armature the maximum variation in the number of teeth at one time under the pole-face amounted to a whole tooth, the greatest possible. If the width of the face had been a multiple of the pitch of the teeth these oscillations, which were probably due to the variation in reluctance of the main magnetic circuit, would apparently have been greatly reduced, if not annihilated altogether. They were least with closed slots on open circuit and inductive load, and greatest with closed slots on non-inductive load, the increase in the latter case being probably due to the saturation of the bridge over the slot by the local flux produced by the armature current.

The effect of the oscillations in the main magnetic circuit on the p.d. wave is to cause ripples, which exhibit a periodic discontinuity of phase at the neutral plane, when the ripples are at zero value; at that instant the teeth are symmetrically arranged about the pole face. The ripples are affected in magnitude by the varying impedance of the load, which, with inductive loads, is far higher for the high-frequency ripples than for the main current; hence the ripples are least on inductive load, and equal in magnitude on open-circuit and non-inductive load.

Discussion.

Mr. W. Cramp, in a communication, said that as a designer he felt that the results were of the greatest possible importance. He noted the enormous difference between closed and open slots in the percentage of moving flux; so marked was this that he saw no necessity even for laminated pole faces with closed slots. The difference in e.m.f. wave form for closed and open slots appeared to him to be what one would expect, except in one particular, viz, that there seemed to be no reason whatever why the "drag" should have become quicker than the "flash;" indeed, he could hardly believe this was the case. He doubted if Mr. Worrall's explanation of the oscillations in the neutral plane was correct. What reason was there to suppose that they were not due to ordinary interpolar induction?

Dr. E. W. Marchant said the results were very complicated, and required very careful study to understand them. He thought the most important point was the e.m.f. wave form with open and closed slots. It depended, he thought, on the width of bridge across the slot, and it would be interesting to have the relative magnitude of e.m.f. in closed slots in opposition to open slots.

Mr. M. B. Field said the practical man wanted to know what effect the oscillations had on the price and efficiency of the machine; he hoped that on a future occasion the author would deal with this point. If it did not affect the efficiency, there the matter ended; if it did affect it, then it was of the utmost importance.

Mr. H. W. Wilson thought from the paper that there were better results with closed than with open slots, but questioned whether the extra cost of winding with closed slot would not absorb all that was saved by the difference in efficiency.

Mr. Worrall replied to the discussion.

The Physical Society.

At the annual general meeting, held February 8th, 1907, Prof. J. Perry, F.R.S., President, in the chair, the report of the Council was presented. The number of Fellows now on the roll is 426. Arrears of subscriptions stand at a higher figure than for some time past. With this exception, the position of the Society is fairly prosperous. The following Officers and Council were elected for the ensuing year:—

President.—Prof. J. Perry, F.R.S.

Vice-Presidents.—Those who have filled the office of President, together with C. Chree, D.Sc., F.R.S.; H. M. Elder, M.A.; Prof. J. A. Fleming, M.A., D.Sc., F.R.S.; and W. Watson, D.Sc., F.R.S.

Secretaries.—W. R. Cooper, M.A., and Prof. W. Cassie, M.A.

Foreign Secretary.—Prof. S. P. Thompson, D.Sc., F.R.S.

Treasurer.—Prof. H. L. Callendar, M.A., F.R.S.

Librarian.—W. Watson, D.Sc., F.R.S.

Other Members of Council.—T. H. Blakesley, M.A.; A. Campbell, B.A.; W. Duddell; A. Griffiths, D.Sc.; J. A. Harker, D.Sc.; T. Mather, F.R.S.; A. Russell, M.A.; S. Skinner, M.A.; S. W. J. Smith, M.A.; Prof. H. A. Wilson, F.R.S.

Prof. A. Lippmann and Prof. S. Newcomb were elected Honorary Fellows of the Society.

The President then delivered an address on the teaching of elementary mechanics. It was time that the schoolmaster should recognise that engineers' units based on the weight of 1 lb. in London were as absolute as any other units could possibly be, and when the schoolmaster rejected the term centrifugal force, he merely showed that he had done no advanced work in kinetics. It was the same with the pound as a unit of force. By simple experiments a young student should be given the fundamental idea that force is (vector) rate of change of momentum, and his real knowledge of mathematics would increase greatly. The teaching of mathematics was a subject of enormous interest. It never seemed to occur to the orthodox mathematician that much of the work he tried to give the schoolboy was work that ought not to be touched by a man until after he was a wrangler. If mathematical gymnastics were wanted, they could be obtained in large quantity in the use of the calculus in its interesting applications. The classes in practical mathematics were showing that a Board School boy, after 50 lessons, could use the idea of rate, and could differentiate and integrate practically all the functions which were of use in engineering. He considered the elementary use of the calculus, and even the solution of easy differential equations, a school, and not a university subject.

An ordinary meeting of the Society was then held, and Mr. A. Russell read a paper on "The Magnetic Field and Inductance Coefficients of Circular, Cylindrical and Helical Currents." The author gives formulæ for the magnetic force near a circular current which can be readily evaluated. He then shows how the self-inductance of a ring of wire and the mutual inductance between two coaxial circular filaments can be found without using Neumann's theorem. When the length of a helix is greater than twice its diameter and the pitch of the helix is small, the self-inductance L is given by

$$L = 2^2 (a^2/h) N^2 [1 - 4\ a/3\pi h + a^2/8\ h^2 - a^4/64\ h^4],$$

where N is the number of turns, $2a$ the diameter and $2h$ the axial length. The maximum inaccuracy of this formula, as compared with the more accurate elliptic integral formula, is less than 1 in 8,000. The author has found this formula useful in practical work.

Society of Motor-Omnibus Engineers.

The adjourned discussion on Messrs. Hart and Durtnall's paper on "Petrol Transmission for Road Vehicles, in Comparison with Purely Mechanical Systems," took place on Monday, February 4th. A very admirable feature of these meetings is that the members foregather in the refreshment room for half an hour before the time of the ordinary meeting, where, over a cup of coffee and a sandwich, they have a pleasant causerie which cannot fail to have a marked effect on the after discussion. We should like to see an extension of this system to the older Institutions.

Mr. Frost Smith, who opened the discussion, laid great stress on the cost of upkeep of clutches, gears, bearings and other working parts of existing types of mechanically-propelled vehicles, due

very largely to the exceedingly rough treatment to which they are subjected by the drivers. He also showed how difficult it was now to get new 'buses passed by the police authorities owing to noise and other objectionable features. Ordinary bearings, he said, were now a thing of the past, roller or ball bearings were a necessity. After a wide experience with all sort of drives, he was now a convert to the live-axle system. If the Hart-Durtnall system could do what was claimed for it, he would welcome it, and be prepared to sacrifice a little weight and efficiency.

Mr. T. Parker, jun., read a carefully-prepared criticism of the paper. (The practice of reading speeches is a little overdone at the meetings of this society.) The paper, he said, did not justify its title; instead of a comparison of petrol-electric and mechanical systems of propulsion, the authors gave descriptions of no less than 18 petrol-electric systems, mostly existing only on paper, and four ancient systems upwards of 400 years old. He criticised the high gear ratio, the consequently high H.P. and the weight of the H.D. system. Whereas the authors gave the weight of the electrical gear as about half a ton, Mr. Parker maintained that a 40-H.P. motor and generator together with clutch gear, &c., would weigh something like 4 tons. He doubted the system, expressing his desire to see the 'bus negotiate successfully the Finchley route. He then described an ingenious form of new clutch, and also referred to the Pittler hydraulic system of transmission, of which he appeared to think very highly.

Mr. Douglas Mackenzie asked for calculations as to cost of maintenance. The question, said he, was not one to be decided by ingenuity or cleverness of design, but by cost. He had heard of petrol-electric 'buses consuming 2 gallons of petrol per mile, what was the figure for the Hart-Durtnall system? Whilst agreeing with Mr. Frost Smith on the question of bearings, he pointed out the limitations of the live axle.

Mr. Wyatt and Mr. Carter both asked for comparisons of costs of the H.D. and other systems.

Mr. Frank Broadbent grouped petrol-electric systems into two classes, viz., those which employed batteries to assist the engine in starting the car and on gradients, and those in which no batteries were used. In the latter the engine must necessarily be sufficiently powerful for the maximum load. Speaking from a wide experience with both continuous and polyphase motors, he held that the polyphase was the simpler, and would stand overloads and rough treatment better than the continuous current motor. In the Hart-Durtnall system the exciter and controller dealt with only a fraction of the total current, so that the upkeep would be less than in a continuous current system where the commutators and controllers were subjected regularly to excessive currents. He described the polyphase motor as simply a frictionless slipping clutch, and pointed out that its chief function on the H.D. 'bus was to start the car and not to drive it. It could therefore be made much smaller than a continuous current motor which was in continual operation. He foresaw trouble, however, in hill climbing, when the motor was in use, and predicted that the rotor exhibited at the previous meeting would burn out in a quarter of an hour if it transmitted anything like 40 H.P.

Mr. Beaumont, jun., considered that the apparent advantage of ball bearings was due to the fact that they could digest the bits of metal broken off by the jolting in a way that was not possible with solid bearings. He commented on the easy way in which an electrically-propelled vehicle starts as compared with one driven directly by the petrol engine

Mr. Durtnall, with remarkable intuition, had so forecasted the trend of the discussion that he was able to read a lengthy reply thereto, which was written out before the meeting. A considerable portion of this was addressed to Mr. Hobbs, who, as a visitor remarked, appeared to be looked upon as the "opposition." Mr. Durtnall pointed out that the only continuous-current machine was the series-wound exciter, and this was liberally rated and not cut down for lightness as is necessary with D.C. motors when used for driving. He gave the efficiency of the electrical system as 66·5 per cent. when hill climbing, with 61·2 per cent. reduction in speed. The motor would exert a starting torque of 432 lb.-ft., whilst the torque actually required to start the 'bus on the level was 192 lb.-ft. When running direct at 12 M.P.H., the efficiency was said to be 97 per cent., but this clearly referred to the efficiency of the magnetic clutch only. An ingenious method of solenoid-throttle control was described. Discussing the relative merits of polyphase and D.C., the authors pointed out that they had a D.C. system, which they used on such vehicles as brewers' vans, &c., where the duty was not so severe as 'bus service. They reiterated that the additional weight involved by their equipment was not more than 500 lb. as compared with the ordinary petrol vehicle, and agreed with Mr. Broadbent that it was the objections to two trolley wires that had kept back polyphase tramways, and not the question of motors. The simplicity of operation when following up traffic, viz., by means of a foot brake which short-circuited the exciter field before applying the brake, and the gradual building up of the field and gentle starting up of the 'bus on releasing the pedal were emphasised.

The reply was given with considerable spirit, and many amusing asides by Mr. Durtnall provoked considerable merriment among the audience.

Mill Hill School Telephones.—The Electrical Engineering and Maintenance Co. have recently carried out an installation of their magneto intercommunication telephones throughout the Mill Hill Schools; lead-covered paper-insulated cables have been run on poles connecting the various out-buildings.

WOOLWICH ELECTRICITY UNDERTAKING.

SIR A. B. W. KENNEDY'S REPORT.

At the meeting of the B.C. on the 14th ult. the Electricity Committee presented a report by Sir A. B. W. Kennedy upon the electric light undertaking. The report extended over nine and a half pages of print, and the principal conclusions and recommendations were summed up by Sir Alexander towards the end as follows:—"The capital expenditure on the undertaking has been so great, and the capital charges per unit are therefore so large, that as long as the average price charged per unit remains no higher than at present it is impossible that, for a number of years to come, the undertaking can show any balance on the right side, although as time goes on both the capital charges and the working costs per unit generated will naturally decrease. (2) The only way in which it could be made certain that the accounts should show a credit balance would be by an increase in the average price received per unit, and this can only be reached by an increase in the rate charged to consumers, especially to the very large number of consumers whose load factor is extremely small. This being absolutely the only *direct* way in which the accounts can be made to balance and the responsibility removed, or partly removed, from the shoulders of the ratepayers to those of the consumers of electricity, I have felt bound to put it before you, and I hope it will not be rejected without due consideration. But, of course, it is obvious that the difficulties in the way of adopting this course are very great, and may prove insurmountable. In that case there remains only to be considered how the inevitable loss can be minimised. (3) The fact that you have built the Plumstead station in addition to the older station at Woolwich, and that at present you have a dual system of supply, and to a very large extent an indirect system, has been the cause of your large capital expenditure, and is at present the cause of considerably increased working costs. I strongly advise that the work at the Plumstead station be limited as far as possible to what can be done by the help of steam obtained there from the destructor, which would, I believe, be sufficient almost continuously for all the direct-current plant at Plumstead, and also for the supply of the Eltham and Lee district by the method which I have suggested. All further extensions of plant necessary for the borough should be carried out at the Woolwich station, and as soon as sufficient direct-current plant has been placed there, the use of the large alternators at Plumstead, which are now supplying current in Woolwich in a very wasteful fashion, should be discontinued, and the whole of Woolwich supplied with continuous current direct from the Woolwich station. For this purpose there would be a considerable amount of alteration to be carried out at the station, but the actual capital cost of the scheme would not be so great as if new plant were put in at Plumstead, as high-tension plant, with high-tension mains to Woolwich, and with motor-generators at Woolwich, while the working costs of the undertaking as a whole would be much reduced. The existing high-tension plant at Plumstead, with the motor-generators at Woolwich, would remain as reserve plant to be used either for Woolwich or Eltham in the case of the breakdown or temporary overhauling of the continuous-current plant, and would, therefore, enable you to do without ordering additional *spare* plant for a long time to come. In order to save capital cost, at least two of the Plumstead boilers might be removed to Woolwich to take the place of the locomotive boilers, which are practically of little further use. (4) In view of the fact that for next winter, 1907-8, further plant will certainly be required at Woolwich, I have suggested that it would be wise for the Council at least to consider whether there is any possibility of obtaining as much energy as would suffice to meet their wants from the South Metropolitan Co. on such terms as would render any further expenditure of capital on the part of the Council unnecessary. I have, however, no personal knowledge as to whether the South Metropolitan Co., or any other undertaking, could offer the Council continuous current at rates which would be remunerative. (5) As to the engineering working costs, your staff are reducing these rapidly. I think a considerable saving could be made when the Plumstead output is reduced, by a redistribution of the hours during which the destructor boilers are fired, but this is a very simple matter. Naturally, when you are able to discontinue the wasteful indirect supply to Woolwich through the high-tension machines at Plumstead, you will save very considerably in your working costs, not only because of the reduced number of men employed, but because of the fact that you will sell and be paid for probably 80 per cent. of the units generated, instead of the present figure of 52 per cent. As to the costs of management—during the last year a very large expenditure has been incurred in management and account keeping on account of the large amount of time which the borough treasurer's department has had to give to this matter. Once the accounts have been got into proper order by the borough treasurer, however, I should think it would be possible for this part of the charges to be very much reduced in future, and a not inconsiderable saving made in this way. Of course, a very large part—indeed, the greater part—of this expense has been in connection with the accounts of the wiring and motor department, and would come to an end altogether if that department were closed, as I suggest that it should be."

In a postscript, Sir Alexander Kennedy stated that after perusing the auditor's report dated January 2nd, 1907, he found that his estimates as to the probable financial results of the working of the undertaking were considerably too favourable, and that the period mentioned in his report (five years), during which the undertaking will probably be a charge on the rates, should be doubled.

The Electricity Committee stated in a report upon the foregoing that many of the recommendations involved inquiry

which must of necessity occupy some time before they can result in any definite proposals, but there was one matter, namely, the proposal to close the wiring department, upon which it had no difficulty in coming to a conclusion. The wiring department, from its inception on December 17th, 1903, to March 31st, 1906, had resulted in a total net loss of £2,170. As far as could be ascertained, the loss for the nine months ending December 31st last would be £826, and the auditor had expressed his intention of debiting the revenue account of the department with a further sum of £365 in respect of value of capital assets on March 31st, 1906, reduced by payment of instalments on hire-purchase agreements, which will have the effect of increasing the total loss of that department at that date to £2,536. The last Council in framing the annual estimates for the current year credited a sum of £600 to the wiring department as a contribution from the general electricity account as representing commission alleged to be earned by the wiring department on lamps connected. From the manner in which the auditor had dealt, and evidently intended to deal, with the accounts of the electricity undertaking there could be no doubt that this £600 would be disallowed at the next audit. The loss on the department for the year ending March 31st, 1907, would probably amount to £1,400. Sir Alexander Kennedy, in dealing with the department, says:—"I am sorry to say that I can only advise you that the sooner this department is discontinued the better for the undertaking. I feel sure from what I have seen of the accounts, and the way in which various items have been charged, that the real loss is even greater than the apparent loss, but even taking the figures as they stand, it will be better for you to face the loss that has been made than to continue in a business which must almost inevitably lead to further losses," and further on in his report he says:—"It has been found over and over again that this class of business can only be made to pay by a very active and vigorous contractor, with ample experience and knowledge of estimating and of store keeping and working under regular business conditions," and in conclusion upon this subject, he says:—"I can only say again that it would be desirable in the best interests of your Council to discontinue this department with the least delay possible, and put up with whatever loss you have actually incurred. I do not think you would find any difficulty in doing as, I believe, other municipal authorities have done, and making suitable arrangements with local contractors to carry out the work at prices which you could approve, and, if necessary, under certification and test by your own engineer." The district auditor in his report in reference to this department says: "I must fully endorse the financial conclusions on which the consulting engineer bases his advice to discontinue this department with the least delay possible." The Committee has stated that there will be no difficulty in making arrangements with responsible contractors to carry out all such work required. In connection with similar powers recently granted to other metropolitan Borough Councils owning electricity undertakings, the Committee stated that the engineers of those undertakings have unanimously decided that in the interests of the undertakings it will be far preferable to make arrangements with responsible contractors to carry out the work under proper supervision and control upon a standard specification and at schedule prices. The National Electrical Contractors' Association are prepared to guarantee work carried out in such cases by members of their Association, and to indemnify the Council against any loss in respect of bad or defective workmanship. The Committee recommended (*a*) That the wiring department be closed as from March 31st, 1907; (*b*) That the wiring stores in hand at March 31st, 1907, be gradually disposed of, if possible to wiring contractors; (*c*) That the Council continue to let out motors and arc lamps on hire without undertaking work in connection with their installation. The chairman of the Committee, in moving the adoption of the report and recommendations, said that the rates would have to go up this year by 1s. in the £, a point never reached in the history of the borough. Of the additional 1s. which would have to be imposed, 10d. was due to the loss on municipal trading. The losses on revenue account had been under-estimated by £10,000 up to March 31st last. Further £1,200 of the deficiency had been covered up by making excessive charges for street lighting. He was glad to be able to bear testimony to the fact that none of the losses were due to the present officials, the electrical engineer, the station engineer, and other members of the staff, who were reducing working expenses.

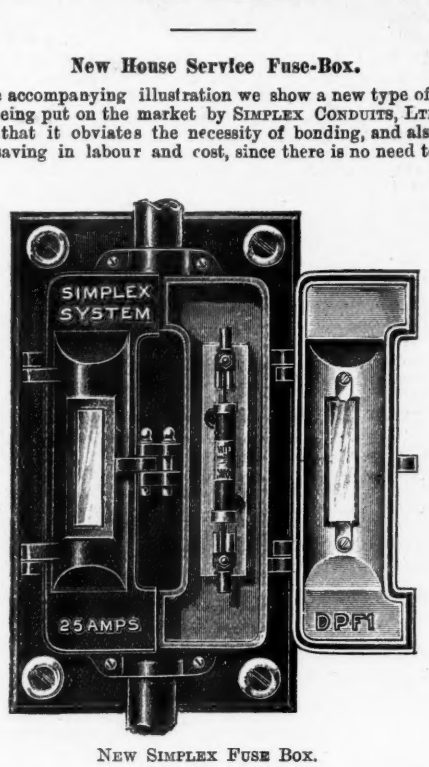
A discussion extending over several hours took place on the report. It was admitted that at present the B.C. was losing £15,000 a year, which was equal to a 5d. rate, on the undertaking, and it was advocated strongly that the concern should be sold to a private company. In the result, the report and recommendations were carried. The borough treasurer was authorised to make arrangements with the London and Provincial Bank for a temporary overdraft of £55,000, the chairman of the Finance Committee explaining that the electricity undertaking was responsible for the greater part of this sum.

Competition at Constantinople.—It is reported from Constantinople that very slow progress is being made in connection with the negotiations proceeding in that city between the "grand master" of the artillery and representatives of English, German and Belgian companies in regard to the projected erection of works for the production of electricity, and for the electric lighting of the town. It is said that the establishment of the works is practically certain to be entrusted to foreign companies, but not the working of the undertaking, as a decided resistance to foreign working exists at the palace.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

New House Service Fuse-Box.

In the accompanying illustration we show a new type of cut-out that is being put on the market by Simplex Conduits, Ltd. It is claimed that it obviates the necessity of bonding, and also effects a great saving in labour and cost, since there is no need to divide



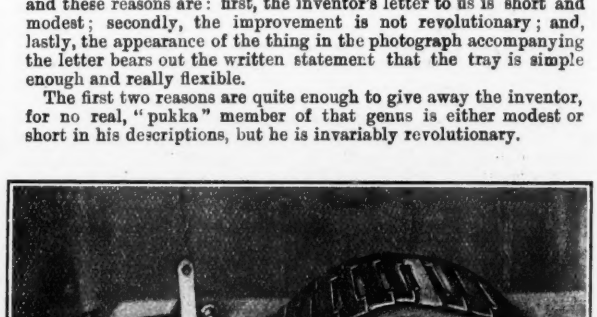
New Simplex Fuse Box.

the main run of conduit by means of tee-pieces and bends. The lower part of the box consists of one complete casting, divided into two compartments, and in each clip terminals for Mordey type fuses and lugs for connecting up the cables are mounted on porcelain bases. It will be noticed that ample room is allowed for making connections. A cover, which has a glass window, is provided for each division, and an interlocking arrangement may be attached, whereby only one cover may be opened at a time, thus avoiding all risks of short-circuits.

Improved Trigger Life-Guard.

Mr. T. Robinson, of Cooper's Lane, Potter's Bar, sends us particulars of a new form of trigger life-guard. We have not seen it in operation, but for three reasons we think that the flexible tray which forms the subject of the invention may be an improvement, not only for the purposes of the Patent Office, but in practice also; and these reasons are: first, the inventor's letter to us is short and modest; secondly, the improvement is not revolutionary; and, lastly, the appearance of the thing in the photograph accompanying the letter bears out the written statement that the tray is simple enough and really flexible.

The first two reasons are quite enough to give away the inventor, for no real, "pukka" member of that genus is either modest or short in his descriptions, but he is invariably revolutionary.



Improved Life-Guard.

After a little more practice Mr. Robinson may improve in these respects, so he must not be downhearted.

The illustration shows the flexible tray in the position which it would take up if dropped on a road with a camber like the longitudinal section of a canal bridge. How much more easily, then, will it accommodate itself to the extremest camber ever seen on the paving of a tramway?

The slats of the tray are articulated somewhat after the fashion of a roll-top desk, and they are held together by flexible steel wires.

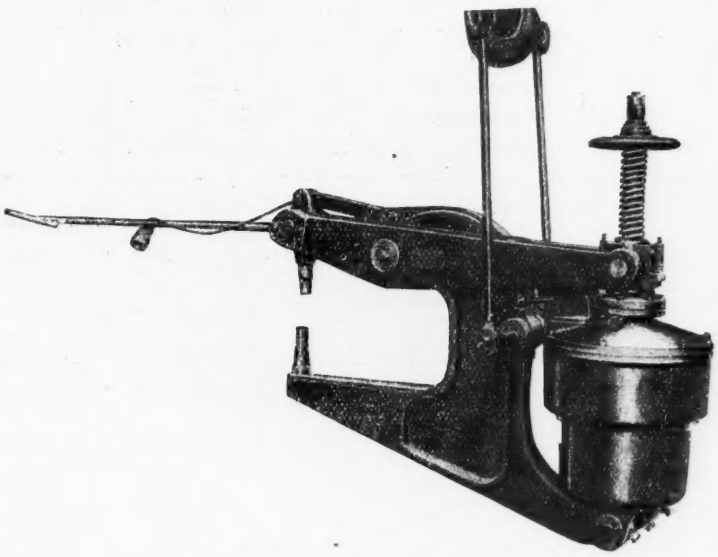
The trigger gate, the levers, and the other parts may be exactly similar to those which are in general use, for we understand the inventor to claim only that the tray will prevent any part of a fallen body being caught between itself and the paving, as conceivably might happen with the rigid tray.

The least we can say is, that *primâ facie*, the improvement is worth a good trial.

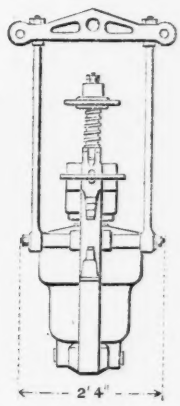
While on this subject we may mention that Mr. P. J. Pringle has devised a simple and effective loose gate for use on those roads on which damage is being done constantly to life-guard gates on the trailing end. Owing to the position of the gates, a comparatively small amount of "galloping" at the truck brings them into contact with the track and forces them outwards. The usual result is that the bottom strip is broken, and often more serious breakage occurs.

Occasionally a cure has been effected by increasing the clearance between the bottom strip of the gate and the track, and this has been carried to such an extreme in some cases that a good-sized child would pass under the gate to a horrible fate.

The clearance ought not to exceed 3 in. at any time, if the apparatus is to earn its title of life-guard; and Mr. Pringle's ingenious modification permits that maximum to be observed, for the trailing gate can swing freely outwards and move freely upwards without releasing the guard-tray, and without damaging itself by attempting to resist the blow of the paving.



Electric Riveting Machine.



End View of Riveter

Electric Riveting Machine.

Although at the present time riveting machines driven by hydraulic or air pressure practically monopolise the field, yet there appears to be a good opening for an electrical riveter for many purposes.

The transmission of hydraulic and compressed air power requires special pipe-lines, which have disadvantages in the way of leakage and inflexibility. Moreover, they require a special power installation, which, in turn, requires experienced attendance. These objections are sometimes so conspicuous that riveting by hand is preferred.

The transmission of energy for the electric riveting machine is done by a simple cable, which can be connected to any electrical circuit near the place of working. This simple and cheap transmission of energy makes the electric riveting machine a most valuable appliance for installations where electric power is already installed or easily to be obtained.

The energy consumption of the riveter is very small; at the moment of riveting it requires less than a normal arc lamp, and in the intervals between riveting it only needs the energy for the motor. For longer intervals the current is taken off entirely; the cost of running is, therefore, very small.

The handling of the machine is very simple. By pressing a button the machine is brought into action, the vertical spindle rotates, screwing up a nut in the end of the double-armed lever, and at the same time forcing down the die at the other end, for forming the rivet head.

Energy is cut off automatically as soon as the riveting is finished and the tongs open, the nut running back to its lowest position. The automatic cut-off, according to the diameter of the rivet, can easily be regulated by a hand wheel. The machine only requires one man in attendance, who can easily move it along the overhead track from rivet to rivet, put in the hot rivets and work the riveter by pressing the button.

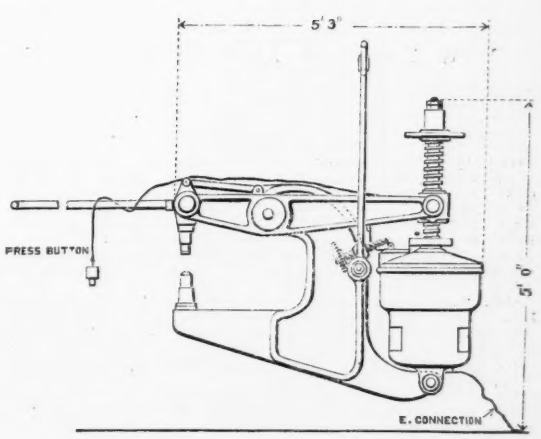
One great advantage is that the rivet can be inserted from above and need not be held at all.

The machine works quite noiselessly and quickly, each rivet being completed in about one second, so that the number of rivets per hour is only limited by the time which is needed for heating and inserting the rivet bolt. The machine is solidly constructed, and all the electrical parts are dust and water-proof. It is suited for hot rivets from $\frac{5}{8}$ in. up to 1 in. diameter; smaller rivets may be riveted cold.

This machine is supplied by Mr. Carl Flohr, of 73A, Queen Victoria Street, E.C., for direct or alternating current operation, and the facility with which it can be handled in ordinarily inaccessible positions is a considerable recommendation.

Sensitive A.C. Voltmeter.

Noting in our last issue an inquiry for a voltmeter having a range of 15 to 50 volts, independent of the frequency and deadbeat, Mr. R. W. Paul, of Newton Avenue Works, London, N., sends us particulars of one which he makes. It is not new, but, we understand, has not previously been described in the technical Press.



Outline Showing Dimensions of Riveter.

The diagram, fig. 2 (p. 376), illustrates the principle of the instrument, the working parts of which comprise two fixed inductors, marked I I, so formed as to leave a cylindrical air-gap into which the suspended needle N, which is suspended co-axially with them, may be attracted. The needle is formed of two very thin aluminium vanes, *b b*, also shaped into segments of a cylinder, and bolted to the vertical staff. Both needle and inductors are made of aluminium, and great care is taken to bring them into similar physical conditions, so as to eliminate the error due to contact difference of potential. As shown in fig. 1, the inductors are mounted on a metal platform carried on insulating glass or amber pillars, and are connected to one terminal of the instrument.

The needle is suspended and connected by a phosphor-bronze strip to a torsion head, on turning which the zero may be adjusted

without opening the case, the torsion head being provided with a tangent screw adjustment for this purpose. The mirror is shielded by a brass tube from outside electrostatic influence, and, by attaching a light vane to the mirror and enclosing it, the movement of the needle may be heavily damped. Surrounding the

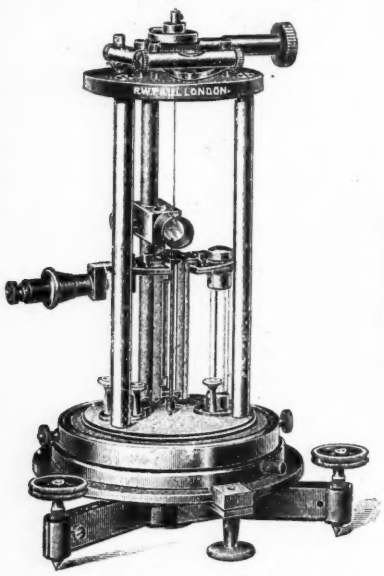


Fig. 1.—Paul's Sensitive A.C. Voltmeter.

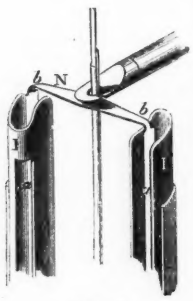


Fig. 2.

working parts shown in the illustration and connected to them, is an inner case which shields the whole from external electrostatic attractions, while an outer case, through which the terminals pass with air insulation, protects the whole.

The readings on the scale are proportional to the squares of the pressures on the terminals. By means of non-inductive shunts the instrument is made capable of reading small alternating currents of any frequency. Various ranges are made for pressures 1 to 7 volts, 4 to 30 volts, 8 to 60 volts.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

10,249A/06. "Improvements in translating systems for electric telegraph." I. Kitsee. (Date applied for under Rule 5 of the Patents Rules 1905, May 2nd, 1906.) February 12th. (Complete.)

13,126A/06. "Improvements in the manufacture of metal articles by electro-deposition." S. O. Cowper-Coles. (Date applied for under Rule 5 of the Patents Rules 1905, December 5th, 1906.) February 14th.

3,334. "Improvements in or connected with sound signalling on street, road, or like electrically and other self-propelled vehicles or locomotives." J. Taylor. February 11th.

3,342. "Improved holder for electric glow lamps." J. A. Gee. February 11th.

3,349. "Improvements in electric ignition spark plugs." R. Kennedy. February 11th.

3,354. "Improvements in central battery telephone switchboard circuits." J. A. Marshall. February 11th.

3,380. "Improvements in wireless telegraphy." L. de Forest. (Date applied for under Patents Act, 1901, February 14th, 1906, being date of application in United States. February 11th. (Complete.)

3,381. "Improved high-tension magneto-electric ignition apparatus." G. A. Unterberg and F. Helmle, trading as Unterberg & Helmle. February 11th. (Complete.)

3,398 "Improvements in automatic switch shifting mechanism." J. D. Burkholder. February 11th. (Complete.)

3,411. "Improvements in electric current generators." J. Erpelding. February 11th.

3,426. "Improvements in telephone exchange apparatus." W. H. Wheatley. (C. D. Enochs, United States.) February 11th. (Complete.)

3,432. "Improvements in or relating to electric switches." A. Edgar, sen., and A. Edgar, jun. February 11th.

3,437. "Improvements in incandescent electric lamps." M. C. Clutterbuck. February 12th.

3,462. "Improvements in induction coils." J. H. Chambers and P. F. B. Bennett. February 12th.

3,470. "Improvements in switch-throwing mechanism." L. E. Steel. (Date applied for under Patents Act, 1901, February 12th, 1906, being date of application in United States.) February 12th. (Complete.)

3,483. "Improvements relating to the ignition coils of automobiles and the like." The Electric Ignition Co., Ltd., and F. H. Hall. February 12th.

3,505. "Improved construction of appliances for producing electric light displays." H. N. Dakhyl and A. Galanti. February 12th.

3,522. "Improvements in and connected with the indication of the blowing of fuses in electrical distribution systems." F. Schultz. (Date applied for under Patents Act, 1901, February 14th, 1906, being date of application in Germany.) February 12th. (Complete.)

3,543. "Improvements in electric heating-pads." L. W. Shellhamer. (Date applied for under Patents Act, 1901, April 2nd, 1906, being date of application in United States.) February 12th. (Complete.)

3,544. "Improvements in electric meters." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) February 13th.

3,564. "Improvements in universal joints for electric light fittings and for other purposes." C. Willmott. February 13th.

3,575. "Automatic electric appliance to give two separate indications on a locomotive and same to train guard; one for signal at danger, the other for a signal at safety." J. Nimmo. February 13th.

3,593. "Improvements in automatic switches." H. C. L. Holden and G. K Buller Elphinstone. February 13th.

3,599. "Improvements in telegraphony." G. Morin. February 13th. (Complete.)

3,613. "Improvements in automatic periodically-operated electric switches." J. Gunning. February 13th.

3,631. "Improvements in iron electrodes for accumulators with alkaline electrolyte, and method for manufacturing same." E. W. Jungner. (Date applied for under Patents Act, 1901, February 14th, 1906, being date of application in Sweden.) February 13th. (Complete.)

3,639. "New or improved electrically-operated automatic fog-signalling apparatus for railways." J. McGurk. February 14th.

3,642. "Automatic electrical and magnetic thermostatic regulator. W. H. Hann. February 14th.

3,669. "Combinated electrical switch." E. E. Bartlett and C. H. O. Shanks. February 14th.

3,711. "Method of producing electro-active cement-like substances of iron and nickel hydrates for forming electrodes and accumulators constructed with such electrodes." E. W. Jungner. (Date applied for under Patents Act, 1901, February 15th, 1906, being date of application in Sweden.) February 14th. (Complete.)

3,714. "Improvements relating to cameras for producing photographs by electro-chemical or the like means." F. O. Trautmann. February 15th.

3,724. "Improvements in electrical generators for flour bleaching and subsidiary purposes." F. H. Loring. February 15th.

3,731. "Improvements in bulbs, shades, globes or the like for electric and other lamps specially applicable for advertising purposes." W. C. Thorne. February 15th.

3,739. "Improved method of and means for automatically equalising the power supplied to electric motors subjected to an intermittent load with the object of equalising the demand on the generating plant." The Lancashire Dynamo and Motor Co., Ltd., F. G. Warburton and A. H. Kelsall. February 15th.

3,740. "Improvements in apparatus for controlling the supply of electrical energy from alternating current electric generators or mains to alternating current electric motors." A. P. Wood, R. S. McLeod and The Lancashire Dynamo and Motor Co., Ltd. February 15th.

3,750. "Improvements in electrical connectors." J. H. Tucker. February 15th.

3,757. "Improvements in and relating to guards or cages which are particularly applicable for use with incandescent electric lamps." J. B. Brown, A. Brown and A. Gresty. February 15th. (Complete.)

3,778. "Improvements in electric vibrators and the like." Siemens Bros. and Co., Ltd. (Siemens & Halske Akt. Ges., Germany). February 15th. (Complete.)

3,783. "Improvements in or relating to transmitting systems for wireless telegraphy." M. Levy. February 15th. (Complete.)

3,786. "Improvements in and connected with electric batteries." C. L. Cartwright. February 15th.

3,790. "Improvements in or relating to destination indicators and the like for motor-cars and other vehicles." A. Loebl and The British Ever-Ready Electrical Co., Ltd. February 15th.

3,803. "Improvements in electric resistance furnaces." C. Fery and C. Langlet. (Date applied for under Patents Act, 1901, February 17th, 1906, being date of application in France.) February 15th. (Complete.)

3,809. "Improvements in regulating arrangements for electrically-driven hoisting or winding engine installations." Felten & Guilleaume-Lahmeyer-werke Act.-Ges. (Date applied for under Patents Act, 1901, February 15th, 1906, being date of application in Germany.) February 15th. (Complete.)

3,834. "Method for the production of electrodes of magnetic metals by means of electrolytic oxidation, electrodes produced in this manner, and accumulators provided with such electrodes." E. W. Jungner. (Date applied for under Patents Act, 1901, February 16th, 1906, being date of application in Sweden.) February 15th. (Complete.)

3,850. "Improvements in and relating to trolley wheels as used in the trolley-heads of electric tramcars worked on the overhead trolley system." A. T. Birkby and F. E. Birkby. February 16th.

3,880. "Improvements in systems of electrical distribution." P. C. Hewitt. (Date applied for under Patents Act, 1901, March 14th, 1906, being date of application in United States.) February 16th. (Complete.)

3,881. "Improvements in variable-speed electric motors or variable-voltage generators." L. Torda. February 16th.

3,904. "Improvements in dynamo-electric machines." M. Latour. (Date applied for under Patents Act, 1901, February 16th, 1906, being date of application in France.) February 16th. (Complete.)

3,908. "Improvements in or relating to electric cranes, winches, and the like." The Sunderland Forge and Engineering Co., Ltd., and W. Blair. February 16th.

3,914. "Improvements in electric furnaces." A. Reynolds. February 16th.

3,915. "Improvements in electrical heating apparatus." A. Reynolds. February 16th.

3,923. "Improvements in electric incandescent lamps for advertising purposes." F. Laws, J. Petrie and J. R. W. Middleton. February 16th.

3,927. "Improvements in and relating to electric servo-motors." M. Couade. (Date applied for under Patents Act, 1901, August 13th, 1906, being date of application in France.) February 16th. (Complete.)

3,933. "Improvements relating to electric wavemeters." S. Eisenstein. February 16th. (Complete.)

3,935. "Improvements in or relating to telephonic apparatus." E. A. Graham. February 16th.

3,938. "Improvements in or relating to the manufacture of incandescent lamps with wolfram incandescent bodies." Consortium für Elektrochemische Industrie G.m.b.H. (Date applied for under Patents Act, 1901, February 21st, 1906, being date of application in Germany.) February 16th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1906.

Party-Line Telephone Systems. N. S. McKinsey. 9,583. April 24th.

Trolleys for Electric Motor Cars. R. Arno and Negro. 11,839. May 21st.

Mechanical Rectifiers for Alternating Currents. A. Soulier. 11,989. May 27th. (Date applied for under International Convention, September 2nd, 1905.)

Electrically Operated Apparatus for Shutting Off the Supply of Gas or the like in case of Fire. A. W. Jenczewsky. 13,670. June 14th.